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**ABSTRACT:**

This document represents the Committee Draft for Comment version of ISO 10303 Part 226 that deals with ship mechanical systems data representation for the purpose of electronic data interchange. Ships mechanical systems, within the scope of this standard, include ship's propulsion systems, auxiliary systems and deck machinery systems, together with their components. Product data pertaining to all lifecycle phases of ship mechanical systems are in the scope of this standard. The lifecycle phases covered include specification, selection, installation, commissioning, operation, in-service inspection, maintenance and decommissioning.

**KEYWORDS:**

application protocol; ship equipment; ship machinery; ship mechanical systems; ship propulsion system; ship auxiliary systems; lifecycle; mechanical product.

**COMMENTS TO READER:**

This document has been reviewed and noted by the ISO TC 184/SC4 Quality Committee and SC4 Secretariat and has been determined to be ready for review by the international industry as the Committee Draft for Comment document. This is the third Working Draft of AP226 and contains all the major amendments due to the international industrial review of previous Working Draft as documented in report ISO TC184/SC4/WG3 N703 dated 13 January 1998.

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## Foreword

The International Organization for Standardization (ISO) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO Technical Committees. Each member body, interested in a subject for which a Technical Committee has been established, has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by Technical Committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-226 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration, Subcommittee SC4, Industrial data*. Many organisations have contributed and sponsored the development of this standard through various projects. The contributions of the following are acknowledged:

- **ShipSTEP**: A European industry funded project, ran from 1994 to 1996, with 8 European companies contributing to the development of shipbuilding Application Protocols.
- **EMSA** (European Marine Step Association): EMSA was founded in 1995 to co-ordinate European Marine Step developments and embraces the main European Shipbuilders, Classification Societies and marine software vendors.
- **NIDDESC II** (Navy Industrial Digital Data Exchange Standards Committee): The USA Navy Industrial Digital Data Exchange Standards Committee was formed in 1986 as a cooperative effort by the Naval Sea Systems Command (NAVSEA) and the National Shipbuilding Research Program (NSRP) to collect and exchange information on product model data requirements and to ensure that benefits expected by industry and Navy are incorporated into national and international data exchange standards. The NIDDESC effort has resulted in the development of a suite of product model data exchange specifications. These exchange specifications have been submitted to the ISO TC184 SC4 in 1993 for inclusion in the series of ISO 10303 application protocols, which form the ship product model data.
- **EDIMAR** (Electronic Data Interchange in the European MARitime Industry): European Union funded project, ran from 1997 to 1998, with 11 European companies contributing to the development of the shipbuilding aspect of AP226.
- **AP226 EWGs** (Expert Working Groups): Many organisations have contributed to this part through active participation in AP226 EWGs within which the application experts' view and consensus were sought with regard to industry requirements.

## Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of product and independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organised as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series. This part of ISO 10303 specifies an application protocol (AP) for the exchange of data pertaining to all life-cycle phases of ship mechanical systems.

The principal focus of this part of ISO 10303 is:

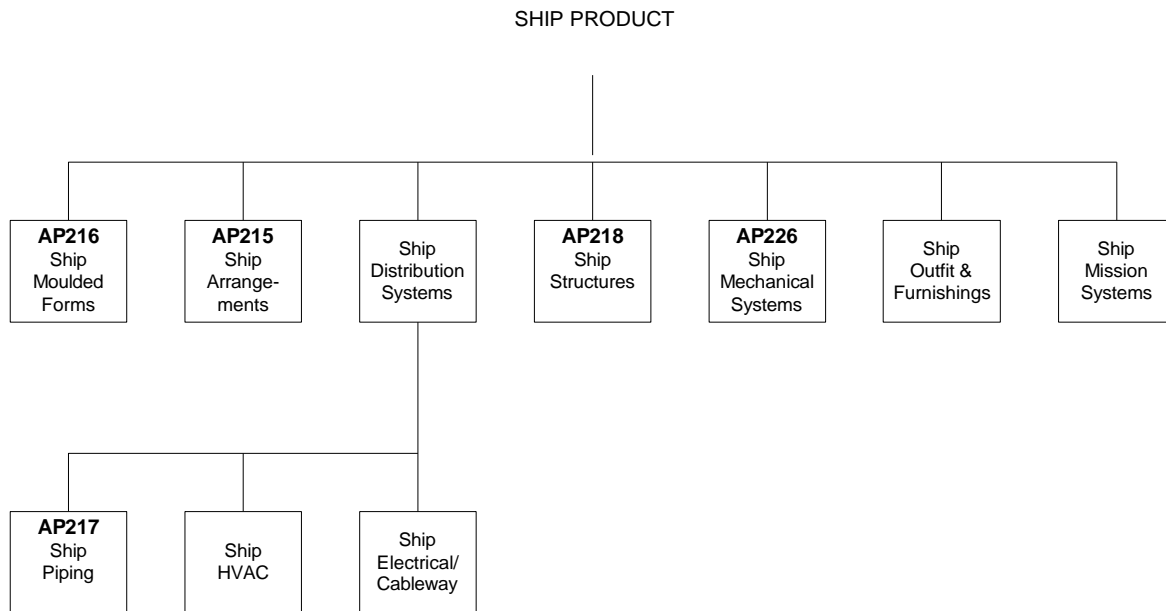
- Ship propulsion system including main engine, propulsor and shafting systems.
- Auxiliary systems including fuel oil, lube oil, power generation, cooling water system, and steam generation systems.
- Deck machinery including cranes, derricks and winches.

This application protocol is one of the series of ship product application protocols as shown in Figure 1. The series of ship industry application protocols assumes that the ship product model can be divided into separate ship systems that each covers a key element of the ship for its whole life cycle. These key elements are:

- ship moulded forms;
- ship arrangements;
- ship distribution systems (piping, heating, ventilation and air conditioning, as well as electrical and cableway);
- ship structures;
- ship mechanical systems;
- ship outfit and furnishings;
- ship mission systems.

Each separate system is described by one or more different application protocols. The full series of shipbuilding application protocols is depicted in Figure 1.

The information requirements for ship mechanical systems have been organised in a series of units of functionality (UoF). Figure 2 shows the units of functionality for this part of ISO 10303 in the form of AP226 data planning model. For further introductory information of STEP, AP226 and its data planning model, please refer to annex L.



**Figure 1 - Ship product application protocols**

**Figure 2 - AP226 Data Planning Model**

This part supports and interacts with the following parts of ISO 10303.

**ISO 13584:** parts library

AP226 supports external references to classes defined by ISO 13584. This part of ISO 10303 supports the exchange of standard parts catalogues used to define specific items within ship mechanical systems. A standard parts catalogue may be exchanged as part of a design, or referenced by a customer to a contractor in order to specify the standard parts that shall be used.

**ISO 10303-221:** Application Protocol: Functional data and their schematic representation for process plant.

This part of ISO 10303 supports external references to classes of properties defined by ISO 10303-221.

**ISO 10303-215:** Application protocol: Ship Arrangements

**ISO 10303-216:** Application protocol: Ship Moulded Forms.

**ISO 10303-217:** Application protocol: Ship Piping Systems.

**ISO 10303-218:** Application protocol: Ship Structures

Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarises the functionality and data covered by the application protocol. Clause 2 provides a list of normative references. Clause 3 lists the vocabulary defined in this part of ISO 10303 and gives pointers to vocabulary defined elsewhere. An application activity model that is the basis for the definition of the scope is provided in annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model (ARM), is given in annex G.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in clause 5.1, shows the correspondence between the ARM and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in clause 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. The expanded listing given in annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex C.



# Industrial automation systems and integration - Product data representation and exchange - Part 226: Application Protocol: Ship Mechanical Systems

## 1 Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for the exchange of ship mechanical systems information.

NOTE 1 - The Application Activity Model (AAM) in Annex F provides a graphical representation of the processes and information flows which are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this Part of ISO 10303:

- The representation of the mechanical systems and their principal components for both naval and commercial ships;
- The product definition data pertaining to the following lifecycle phases of the ship mechanical systems:
  - Specification;
  - Design/Selection;

NOTE 2 - The design data will be supported for those components that are designed and manufactured within the context of marine industry as shown in AAM (Annex F). For example, data necessary to design a diesel engine will not be supported while data required to design a marine propulsor will be supported.

- Approval;
- Installation;
- Commissioning/Acceptance;
- Operation;
- In-Service Inspection and Maintenance;
- Decommissioning/Disposal.
- The product definitions of the following mechanical systems:
  - the components in the systems that supply air to the engine room such as engine room ventilation fans and exhaust gas system such as silencers, economiser and so on.
  - the components in the fuel oil treatment and supply systems, engine lubricating system and engine cooling system.
  - the propulsion system: including main engines, shafts, couplings, gearing and propulsor;

- the manoeuvring system, consisting of the rudder, stock and actuator; thrusters including azimuthing thrusters; hydroplanes stock and actuator; stabilisers; cycloidal propellers type units; pivoting nozzles and water jet type systems.
- the power systems including electric propulsion and auxiliary electrical generation;
- The product definitions of the following mechanical components:
  - the main engine;
  - pumps necessary for the operation of the main propulsion and essential machinery such as boiler feed, condensation extraction, fuel oil pumps, lubricating oil pumps and cooling water pumps.
  - the auxiliary machinery such as heat exchangers, air compressors and air receivers;
  - boilers;
  - auxiliary engines and thruster units;
  - deck machinery such as windlasses, winches, capstans, cranes and derricks;
- The distinction between the physical specifications and the functional specifications of various systems and components.
- The following product definition information:
  - the functional and physical connectivity between components and between systems including physical connectivity of equipment to ship structure;
  - functional description of components and systems such as performance and operational characteristics;
  - geometric representation of systems and components to a level compatible to lifecycle phases of the corresponding system and component;
  - technological information such as material, tolerance, noise, vibration, shock and stress characteristics;
  - data that are necessary for tracking a component's lifecycle and operational history such as specification, in-service inspection and maintenance data.

The following are outside the scope of this Part of 10303:

- the product definition data and physical connectivity pertaining to the following components and systems including:
  - the piping arrangements not integral to the machinery unit;
  - the electrical distribution systems not integral to the machinery unit;



- the control systems not integral to the machinery unit;
- maintenance equipment such as cranes, tools and so on.
- the ship's arrangement and compartmentation;
- the ship's Heating, Ventilation and Air Conditioning (HVAC) systems;
- the mission specific mechanical systems of the ship including:
  - cargo refrigeration
  - naval military equipment
- the outfitting of the ship, including hatch covers, watertight doors, fire fighting appliances, anchor and chain cables, davits and lifesaving appliances, sewage systems;
- data relating to the manufacture of the components.

## 2 Normative References

The following standards contain provisions which, through reference to this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 31:1994, *Quantities and Units*.

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*.

ISO 8824-1:1994, *Information Technology — Open Systems Interconnection — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of Basic notation*.

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*.

ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*.

ISO 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*.

ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts*.

ISO 10303-41:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resources: Fundamentals of product description and support*.

ISO 10303-42:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resources: Geometric and topological representation.*

ISO 10303-43:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resources: Representation structures.*

ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration.*

ISO 10303-45: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resources: Materials.*

ISO 10303-46:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation.*

ISO 10303-49: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 49: Integrated generic resource: Process structure and properties.*

ISO 10303-101: 1994, *Industrial automation systems and integration — Product data representation and exchange — Part 101: Integrated application resource: Draughting.*

ISO 13584-1:, *Industrial automation systems and integration — Parts library — Part 1: Overview and fundamental Principles.*

ISO 13584-42:, *Industrial automation systems and integration — Parts library — Part 42: Methodology for Structuring Part Families.*

ISO 7967-1: 1987, *Reciprocating internal combustion engines — Vocabulary of components and systems.*

ISO 2710: 1978, *Reciprocating internal combustion engines - Vocabulary.*

IEC 50 (191): 1990-12, *First Edition, International Electrotechnical Vocabulary, Chapter 191: Dependability and quality of service.*

ISO DIS 14224: 1997, *Petroleum and natural gas industries – Collection and exchange of reliability and maintenance data for equipment.*

### 3 Definitions and abbreviations

#### 3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1:

- abstract test suite (ATS);
- application;
- application activity model (AAM);
- application context;
- application interpreted model (AIM);
- application object;
- application protocol (AP);
- application reference model (ARM);
- assembly;
- conformance class;
- conformance requirement;
- conformance testing;
- context;
- data;
- data exchange;
- implementation method;
- information;
- integrated resource;
- interpretation;
- model;
- PICS proforma;
- product;
- product data;

- protocol implementation conformance statement (PICS);
- structure;
- unit of functionality (UoF).

### **3.2 Terms defined in ISO 10303-31**

This part of ISO 10303 makes use of the following terms defined in ISO 10303-31:

- conformance testing;
- postprocessor;
- preprocessor.

### **3.3 Terms defined in ISO 10303-41**

This part of ISO 10303 makes use of the following terms defined in ISO 10303-41:

- Address;
- Date;
- Date\_and\_time;
- Label;
- Organization;
- Organizational \_project
- Person\_and\_organization;
- Text.

### **3.4 Terms defined in ISO 10303-42**

This part of ISO 10303 makes use of the following terms defined in ISO 10303-42:

- Cartesian\_point;
- Direction;
- Geometric\_representation\_item;
- Solid\_model;

— Vector.

### **3.5 Terms defined in ISO 10303-43**

This part of ISO 10303 makes use of the following terms defined in ISO 10303-43:

— representation.

### **3.6 Terms defined in ISO DIS 14224**

This part of ISO 10303 makes use of the following terms defined in ISO DIS 14224:

- equipment unit;
- failure mode;
- non-critical failure.

### **3.7 Terms defined in IEC 50(191)**

This part of ISO 10303 makes use of the following terms defined in IEC 50 (191):

- availability;
- availability performance;
- condition monitoring;
- corrective maintenance;
- critical failure;
- downstate;
- failure cause;
- failure rate;
- failure;
- fault mode;
- fault;
- latent fault;
- logistics delay;

- main availability;
- maintainability;
- maintainability performance;
- maintenance;
- maintenance man-hour;
- maintenance time;
- mean time between failure;
- mean time to failure;
- mean time to repair;
- preventive maintenance;
- reliability;
- reliability and maintainability management;
- scheduled maintenance;
- unscheduled maintenance;
- upstate.

### 3.8 Other definitions

For the purposes of this Part of ISO 10303, the following definitions apply:

**3.8.1 acquisition code:** a code number assigned to a product by a purchaser during the order process.

**3.8.2 activity:** anything that is carried out by human or by knowledge-based systems on a mechanical product or in relation to a mechanical product.

**3.8.3 aft:** the location at or near the stern of the ship.

**3.8.4 ambient conditions:** anything relating to a condition of the environment (see 3.8.57) such as temperature and pressure of the ambient fluid. All the conditions that influence the mechanical product and all the conditions resulting from the mechanical product's function are included.

**3.8.5 ambient fluid:** a fluid that surrounds a mechanical product.

**3.8.6 anomaly:** a product problem or enhancement that may result in a change requirement. The product problems are deviations from expected product specification. The product enhancement is a need for improved product specification.

- 3.8.7 approve:** an activity (see 3.8.2) that confirms a mechanical product as being fit for purpose.
- 3.8.8 assembly:** a composition (see 3.8.26) plus the specification of how the things in the composition are related to each other.
- 3.8.9 assess:** an activity (see 3.8.2) that assesses a mechanical product for fitness for purpose.
- 3.8.10 auxiliary:** any support role with reference to a main function (see 3.8.92).
- 3.8.11 auxiliary system:** a system (see 3.8.154) that supports one or more main systems (see 3.8.91). In ship terminology, auxiliary systems refer to those systems that support the propulsion system.
- 3.8.12 azimuth thruster:** a propulsor consisting of a propeller that can be rotated around a vertical shaft.
- 3.8.13 bilge system:** a system (see 3.8.154), comprising pumps, pipes and so on for handling bilge water.
- 3.8.14 bill of material:** a composition (see 3.8.26) plus the identification of all the mechanical products included in the composition.
- 3.8.15 boiler (steam generator):** a type of steam generation system (see 3.8.146).
- 3.8.16 breakdown maintenance:** the maintenance to be carried out after a fault recognition and intended to put a mechanical product into a state in which it can perform a required function.
- 3.8.17 CAD drawing:** a plan (see 3.8.115) prepared by a CAD-system.
- 3.8.18 cargo handling system:** a system (see 3.8.154) whose main function (see 3.8.92) is handling ship cargo.
- 3.8.19 catalogue:** a type of document (see 3.8.48) in printed or electronic format that contains information on one or a set of mechanical products.
- 3.8.20 class:** a concept to group mechanical products, with similar characteristics, with the purpose of describing the common properties of the class members. Each mechanical product belongs to at least one class.
- NOTE 1 - A class usually has a criterion for inclusion or exclusion of mechanical products.
- 3.8.21 classification:** the process of ensuring that a ship is designed, built and maintained to a prescribed standard. This is done by a periodic survey of the ship.
- 3.8.22 classification society:** an organisation that enhances the safety of life and property at sea by providing rules, regulations and personnel for assessing and classifying ships during their life cycle.
- 3.8.23 clutch:** a disengageable connection between two elements in a mechanical transmission system.
- 3.8.24 collection:** a set of things that do not have any relationship to each other apart from being members of the same set.
- 3.8.25 component:** a mechanical product that is part of another mechanical product and has not already been classified as a system (see 3.8.154) or an equipment (3.8.58). A component cannot have a system or an equipment as part of it.

- 3.8.26 composition:** an association that indicates that one mechanical product is composed of many other mechanical products.
- 3.8.27 compressed air system:** a system (see 3.8.154) that produces compressed air to satisfy the requirements of all components that require compressed air to perform their function.
- 3.8.28 compression ratio:** the ratio of the maximum and minimum cylinder trapped volumes of a reciprocating machinery.
- 3.8.29 compressor:** a reciprocating or rotary machinery for raising the pressure of air or another gas.
- 3.8.30 condition based maintenance:** a maintenance to be carried out according to prescribed criteria and intended to reduce the probability of failure or the degradation of a mechanical product.
- 3.8.31 condition monitoring:** a function by which the state of a mechanical product is monitored.
- 3.8.32 configuration:** a data specification that deals with identification, approvals and versioning aspects of a mechanical product or its definitions (see 3.8.43).
- 3.8.33 connecting component:** any intermediary mechanical product including weld, gaskets, bolts, nuts, and so on that are needed in order to realise a connection (see 3.8.34).
- 3.8.34 connection:** an association between two mechanical products that results from a physical joining.
- 3.8.35 connector:** a mechanical product that establishes an interface between two mechanical products or between a mechanical product and other category of items.
- 3.8.36 connector component:** a type of component (see 3.8.25) that plays the role of a connector (see 3.8.35).
- 3.8.37 control:** a function (see 3.8.70) by which a process is controlled.
- 3.8.38 control and monitoring system:** a system (see 3.8.154) with the primary function of controlling and/or monitoring a mechanical product.
- 3.8.39 control equipment:** a non-machinery equipment (see 3.8.58) that is primarily used in the control and monitoring systems.
- 3.8.40 cooling water system:** a system (see 3.8.154) for storing, treating and transporting water at desired temperature, pressure and flowrate to satisfy the requirements of all equipment (see 3.8.58) that require cooling by water.
- 3.8.41 deck machinery:** all types of equipment (see 3.8.58) that are positioned on the ship's deck and perform the operations of mooring, cargo handling and anchor handling including winches, windlasses, capstans, derricks and cranes.
- 3.8.42 decomposition hierarchy:** a systematic breakdown of a mechanical product into its subsystems and components. The decomposition hierarchy for selected mechanical products are documented in Annex M of this part of ISO 10303.
- 3.8.43 definitions:** an aggregation of the information and properties that defines or describes one or many aspects of a mechanical product.



**3.8.44 definitions configuration:** a data specification that defines the configuration (see 3.8.32) for a set of definitions (see 3.8.43).

**3.8.45 design:** a task (see 3.8.155) that creates and defines, with drawings and data, a new version of a mechanical product.

**3.8.46 diesel engine:** a reciprocating machinery (see 3.8.133) operating on the compression ignition and internal combustion principles and used as a prime mover.

**3.8.47 diesel power system:** a power system (see 3.8.119) with a diesel engine (see 3.8.46) as the prime mover (see 3.8.120).

**3.8.48 document:** any type of information content in the form of manuals, computer files, catalogues, reports, books and so on in standard or non-standard formats.

**3.8.49 economiser:** an equipment (see 3.8.58) that uses the energy of the exhaust gases leaving the diesel engine to heat water for ship domestic use or as a feedwater preheater for an auxiliary boiler.

**3.8.50 electric generator:** an electrical machinery (see 3.8.54) that converts mechanical power into electrical power.

**3.8.51 electric motor:** an electrical machinery (see 3.8.54) that converts electrical power into mechanical power.

**3.8.52 electrical equipment:** an equipment (see 3.8.58) that is primarily used in an electrical system. Electric motors and generators are examples of electrical equipment.

**3.8.53 electrical generation system (power plant):** a system (see 3.8.154) that generates electrical energy by converting fuel energy.

**3.8.54 electrical machinery:** an electrical equipment (see 3.8.52) with the function as machinery. Electrical motors and generators are examples of electrical machinery.

**3.8.55 engine room ventilation system:** a system (see 3.8.154) for supplying fresh air to the engine room.

**3.8.56 engineering analysis:** an activity carried out, either manually or by computer, either experimentally or theoretically, in order to develop or verify a theory, or to quantify one aspect of the mechanical product behaviour.

**3.8.57 environment:** anything external to a mechanical product that has a bearing on function and usage of the mechanical product.

**3.8.58 equipment:** a mechanical product that carries out a generally self contained function and to a large extent may be treated as a single mechanical product for the purpose of design, acquisition, or operation. An equipment has both physical and functional properties.

EXAMPLE 1 - A turbocharger is an equipment. A pump is also an equipment.

**3.8.59 equipment condition:** a condition of the equipment that indicates that the equipment's state is just outside the optimum operational limits and that a failure/fault has not been identified in the equipment. Typical conditions are that very small vibrations or increased temperatures have been detected. A condition could be a sign of a latent fault. As soon as a failure/fault is recognised, the equipment state changes from a condition to either a critical or non-critical fault state.

**3.8.60 event and approval data:** a set of data that relates to an event (see 3.8.61) and its approval/authorisation.

**3.8.61 event:** a state which identifies that something has happened at a certain time. A person normally causes the event.

**3.8.62 failure:** the condition of mechanical product under which the expected and satisfactory performance cannot be attained.

**3.8.63 field data:** the performance information and data about an operational product.

**3.8.64 filter:** a device or porous substance through which a gas or a liquid is passed in order to remove solids or impurities.

**3.8.65 fluid distributor:** any equipment (see 3.8.58) or system (see 3.8.154) that is used to distribute or direct fluids.

**3.8.66 fluid mover:** any equipment (see 3.58) that compresses/pressurises a fluid.

**3.8.67 fore:** that part of the ship which is at the front of the ship.

**3.8.68 fresh water:** the processed water on-board ship that is used for utilities.

**3.8.69 fuel oil system:** a system (see 3.8.154) for storing, treating, and transporting liquid fuel to equipment (see 3.8.58) that requires fuel to perform its function.

**3.8.70 function :** the underlying purpose for the existence or the use of a mechanical product.

**3.8.71 functional:** a reference to the actions, activities, or capabilities that a mechanical product provides or may provide to fulfil a purpose.

**3.8.72 functional characteristics:** nomenclature, codes, and named values that describe or specify the performance or behaviour of a mechanical product.

EXAMPLE 1 - Typical functional characteristics of a diesel engine are its speed-power relationships. Typical pump characteristics are its head-flowrate relationships.

**3.8.73 functional specifications:** nomenclature, codes, and named values that describe or specify the performance or behaviour to be met by a mechanical product.

**3.8.74 gas turbine:** a rotating machinery operating on the continuous ignition and internal combustion principle and used as a prime mover (see 3.8.120).

**3.8.75 gas turbine power system:** a power system (see 3.8.119) with a gas turbine engine as the prime mover.

**3.8.76 gear box:** an equipment (see 3.8.58) used for reducing or increasing shaft speed within a transmission system, thereby matching the prime mover to the load. A gear box may also combine two or more shaft inputs into one shaft output or vice-versa.

**3.8.77 general characteristics:** the most general and most widely used information relating to a mechanical product.

**3.8.78 heat exchanger:** an equipment (see 3.8.58) that transfers heat from one medium or system to another.

**3.8.79 inertia:** the tendency of a body rotating about a fixed axis to resist a change in this rotating motion. Normally referred to as moment of inertia.

**3.8.80 inspect:** an activity (see 3.8.2) that assesses a mechanical product against a design or any other specified requirements.

**3.8.81 install:** an activity (see 3.8.2) that fixes the position of mechanical products in physical space and their connections to other types of equipment and systems according to design specification.

**3.8.82 item:** any part, component, subsystem, functional unit, equipment, or system of a ship that can be individually considered. The item refers to all the mechanical, electrical, structural, and other physical elements as well as non-physical aspects such as features and so on.

**3.8.83 life cycle status:** the product data that specify where in its lifecycle the product is.

**3.8.84 liquid impurity:** any type of liquid, at low concentrations, that is part of the composition of a liquid, normally with some harmful effect on the use of the liquid for a specific purpose.

**3.8.85 log:** a structured record capturing specified sets of information at given ship events (see 3.8.61) or at specified time intervals. Deck and engine logs are normally required by law.

**3.8.86 lube oil system:** a piping system (see 3.8.114) for supplying lubricant at the desired temperature and pressure and flowrate to equipment (see 3.8.586) that requires lubrication.

**3.8.87 lubrication oil:** an oil derivative liquid that is used mainly for the machinery lubrication.

**3.8.88 machinery:** a reciprocating or rotating equipment that performs some sort of energy conversion as its underlying function.

**3.8.89 main equipment:** an equipment (see 3.8.58) that provides the main function in a given system.

**3.8.90 main propulsion system:** a propulsion system (see 3.8.126) used to achieve the main ship forward motion.

**3.8.91 main system:** a system (see 3.8.154) that provides the main function (see 3.8.92).

**3.8.92 main function:** the primary role with reference to a function (see 3.8.70).

**3.8.93 maintain:** an activity in which a pre-defined set of tasks are carried out on mechanical products in order to keep them in proper condition.

**3.8.94 maintenance planning:** the function (see 3.8.70) by which the maintenance of a mechanical product is planned.

**3.8.95 manoeuvring propulsion system:** a propulsion system (see 3.8.126) used to carry out the ship manoeuvring in port and in emergency situations.

**3.8.96 manoeuvring system:** a system (see 3.8.154) used to perform planned movement or change from the straight, steady course and speed of a ship or to maintain the vessel in a given stationary location and heading.

**3.8.97 material:** the substance or substances from which a mechanical product or any other physical item is made.

**3.8.98 mechanical component:** a component (see 3.8.25) with a primary mechanical function.

**3.8.99 mechanical connector:** a connector (see 3.8.35) that is primarily used for connecting mechanical equipments together.

**3.8.100 mechanical equipment:** a non-machinery equipment that is primarily used in mechanical systems. Gear boxes and couplings are examples of mechanical equipment.

**3.8.101 mechanical machinery:** a machinery (see 3.8.88) that is primarily used in mechanical systems. All kinds of reciprocating and rotary engines are examples of mechanical machinery.

**3.8.102 mechanical power transmission:** the function (see 3.8.70) of transmitting mechanical power from one point to another point.

**3.8.103 mechanical product:** any item (see 3.8.82) of the ship mechanical systems that is realisable as a physical thing. A mechanical product has both physical and functional properties.

**3.8.104 mechanical system:** a system (see 3.8.154) that is within the scope (see 1) of this part of ISO 10303.

**3.8.105 mechanical transmission system:** a system (see 3.8.154) by which motive power from the prime mover is made available and matched to load. Shafting system connecting main engine to propeller, or shafting system connecting auxiliary engine to electric generators are examples of mechanical transmission systems.

**3.8.106 members of composition:** those mechanical products that appear at the first decomposition level of the decomposition hierarchy (see 3.8.42). The members of composition within this part of ISO 10303 are those specified in Annex M.

**3.8.107 metallic impurity:** any type of trace metal that is part of the composition of a liquid, normally with some harmful effect on the use of the liquid for a specific purpose.

**3.8.108 mounting:** a connection (see 3.8.34), rigid or flexible, between an equipment (see 3.8.58) and the ship's structure.

**3.8.109 operate:** an activity that controls the functioning of a mechanical product.

**3.8.110 part:** any mechanical product at atomic (lowest composition) the level.

**3.8.111 physical:** a reference term which refers to shape and material characteristics such as weight, size, and location of the mechanical product.

**3.8.112 piping connector:** a connector (see 3.8.35) that is primarily used in a piping system for connecting piping equipment or piping parts to each other.

**3.8.113 piping equipment:** a non-machinery equipment that is primarily used in a piping system. Valves are examples of piping equipment.

**3.8.114 piping system:** a system (see 3.8.154) composed of pipes, valves, pumps/compressors, and so on with the main function of transporting and distributing fluids.

**3.8.115 plan:** any type of dimensional drawing of a mechanical product.

**3.8.116 podded drive propulsor:** a type of azimuth thruster (see 3.8.12) consisting of a propulsor, driven from a dedicated prime mover or a pump-jet type propulsor (see 3.8.130).

**3.8.117 port:** a type of connector (see 3.8.35) that enables a flow of energy, load, process material or signal to or from another mechanical product.

**3.8.118 power generation:** the function (see 3.8.70) that converts fuel energy into electrical or mechanical energy.

**3.8.119 power system:** a system (see 3.8.154) that supplies mechanical energy for the operation of another system.

**3.8.120 prime mover:** a type of machinery that converts natural source of energy into mechanical power.

**3.8.121 process equipment:** an equipment (see 3.8.58) that is primarily used in a process plant for carrying out certain processes. Heat exchangers, filters and purifiers are examples of process equipment.

**3.8.122 procure:** an activity (see 3.8.2) by which a specified mechanical product is acquired.

**3.8.123 product configuration:** a data specification that defines the configuration (see 3.8.32) of a mechanical product for the purpose of managing/controlling current status and historical changes of the product.

**3.8.124 product connectivity:** a data specification that defines all aspects of product connections (see 3.8.34) in relation to external systems and equipments.

**3.8.125 product structure:** a data specification that defines the following in relation to a mechanical product: i) the system for which the mechanical product is a part, ii) the items that are part of the mechanical product, and iii) the position and location of a mechanical product.

**3.8.126 propulsion system:** a system (see 3.8.154) that produces the required ship momentum for its forward movement by influencing the velocity of the fluid passing through the propulsor (see 3.8.128).

**3.8.127 propulsion:** the function (see 3.8.70) that produces the required thrust for ship movement using fuel energy.

**3.8.128 propulsor:** a powered equipment that sets up a thrust on the water to enable a ship to move in a controlled direction. Propeller is an example of a propulsor.

**3.8.129 pump:** a rotating or reciprocating machinery that converts mechanical energy into fluid energy in the form of higher fluid pressure.

**3.8.130 pump-jet propulsor:** a pump system that accelerates large volumes of water, drawn in from beneath the ship, and expels it as a high speed horizontal jet, setting up a sufficient reaction force to propel the ship. The pump impeller is mounted with a vertical axis.

**3.8.131 reliability, availability and maintainability (RAM) analysis:** an engineering analysis (see 3.8.56) activity with the objective of defining the RAM characteristic of mechanical products.

**3.8.132 reliability, availability and maintainability (RAM) characteristics:** a set of product- related properties that specifies the reliability, availability and maintainability properties of a product.

**3.8.133 reciprocating machinery:** a machinery (see 3.8.88) that works according to reciprocating motion.

**3.8.134 rotating machinery:** a machinery (see 3.8.88) that works according to rotating motion.

**3.8.135 schematic presentation:** a type of drawing that conveys information about relationships among things by the relative physical position of symbols.

**3.8.136 screw propeller:** a revolving boss with blades that are usually set at an angle and twisted like the threads of a screw. When the propeller is rotated in the water, a column of water passes through it, gaining momentum. The reactive force which arises is taken up by the thrust bearing in the transmission system, enabling the ship to move.

**3.8.137 sediments:** all types of solid impurities of a liquid that normally settle to the bottom of the container of liquid.

**3.8.138 shaft bearing:** a mechanical component (see 3.8.25) for supporting shaft radial or axial load.

**3.8.139 shaft:** a beam (usually of circular section) transmitting torque between the prime mover and the load. A shaft may be part of a series of shafts as in a ship's main propulsion shafting system between prime mover and propeller.

**3.8.140 ship mechanical system:** a mechanical system (see 3.8.104) that provides or performs, or is intended to provide or perform, a service or function contributing to or enabling the operation of a ship.

**3.8.141 ship mooring system:** a system (see 3.8.154) whose main function is to secure a ship in open water.

**3.8.142 ship operation:** all activities required by ship operator and onboard crew to enable the intended services of the ship. In this application protocol the main emphasis is on the technical part of the ship operation. The ship operation phase within the ship lifecycle starts when the ship is commissioned and ends when the ship is scrapped.

**3.8.143 silencer:** an equipment (see 3.8.58) used to reduce the noise emanating from the engine.

**3.8.144 solid model:** a geometric representation of a mechanical product and deals mainly with external geometries including shape, volume, area and so on.

**3.8.145 spatial arrangements:** the location, orientation and relative position of the components of a mechanical system.

**3.8.146 steam generation system:** a system (see 3.8.154) that converts water into steam.

**3.8.147 steam generation:** the function (see 3.8.70) of converting water into steam.

**3.8.148 steam power system:** a power system (see 3.8.119) with a steam turbine (see 3.8.149) as prime mover.

**3.8.149 steam turbine:** a turbine with steam as working fluid.

**3.8.150 steering mechanism:** a system (see 3.8.154) that provides the means of manoeuvring the ship under normal service conditions.

**3.8.151 supercharger:** a mechanically driven centrifugal air compressor used to increase the induction pressure in an internal combustion engine.

**3.8.152 survey planning:** the function (see 3.8.70) by which the survey of mechanical product is planned.

**3.8.153 survey:** the activity of examining one or more mechanical products in order to appraise their condition as being fit for purpose.

**3.8.154 system:** an assembly of one or more items (see 3.8.82), with functional and physical relationships between them, that performs or can perform a clearly identified function (see 3.8.70) as a whole. A system may have both physical and functional properties.

**3.8.155 task:** anything that is carried out by a human on a mechanical product or in relation to a mechanical product. Each task has a clear beginning and ending.

**3.8.156 time based maintenance:** the maintenance to be carried out at predetermined intervals intended to reduce the probability of failure or the degradation of an item.

**3.8.157 transmission (electrical, mechanical, hydraulic):** the function (see 3.8.70) that transfers (electrical, mechanical, hydraulic) power from one location to another.

**3.8.158 tunnel thruster:** a propulsor (see 3.8.128) consisting of a propeller mounted in a fixed tunnel in the ship's structure. Normally used as auxiliary thrust units and are provided to facilitate manoeuvres in tight waters. Bow thruster units on a ferry are examples of tunnel thruster.

**3.8.159 turbine:** a rotating machinery (see 3.8.134) that converts the internal energy of a fluid into mechanical energy.

**3.8.160 turbocharger:** a centrifugal air compressor driven by a gas turbine used to increase the induction pressure in an internal combustion engine.

**3.8.161 water-jet propulsor:** a machinery that takes in water by means of a suitable inlet and ducting system and accelerates the mass of water using an impeller and nozzle to form a jet propulsion system. The impeller is mounted with a horizontal axis.

## 3.9 Abbreviations

For the purposes of this Part of ISO 10303, the following abbreviations apply.

AAM application activity model

AIM application interpreted model

AP	application protocol
BMEP	brake mean effective pressure
BSFC	brake specific fuel consumption
CAD	computer aided design
CFD	computational fluid dynamics
FEA	finite element analysis
IDEF0	ICAM definition language
IMEP	indicated mean effective pressure
MP	mechanical product
PICS	protocol implementation conformance statement
RAM	reliability, availability and maintainability
SI	Système International
UoF	units of functionality



## 4 Information requirements

This clause specifies the information required for the exchange of ship's mechanical systems data.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using the terminology of the subject area of this application protocol.

### NOTES

- 1 - A graphical representation of the information requirements is given in annex G.
- 2 - The information requirements correspond to those of the activities identified as being in the scope of this application protocol in annex F.
- 3 - The mapping table is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to all application protocols.

### 4.1 Units of functionality

This subclause specifies the units of functionality for the Ship's Mechanical Systems application protocol. This Part of ISO 10303 specifies the following units of functionality:

- configuration\_definitions;
- cranes;
- diesel\_engines;
- external\_references;
- gas\_material\_properties;
- lifting equipments;
- liquid\_material\_properties;
- local\_co\_ordinate\_systems;
- machineries;
- maintenance\_tasks;
- measure\_with\_units;
- mechanical\_machineries;
- mechanical\_product\_anomalies;
- mechanical\_product\_components;
- mechanical\_product\_connections;
- mechanical\_product\_definitions;
- mechanical\_product equipments;
- mechanical\_product\_general\_characteristics;
- mechanical\_product\_representations;
- mechanical\_product\_structures;
- mechanical\_product\_systems;
- mechanical\_products;
- other equipments;
- other\_tasks;
- part41\_resources;

- part42\_resources;
- RAM\_characteristics;
- reciprocating\_machineries;
- screw\_propellers;
- ships;
- solid\_material\_properties;
- task\_definitions;
- tasks;
- time\_and\_events.

The units of functionality and a description of the functions that each UoF supports are given below. The application objects included in the UoFs are defined in clause 4.2.

#### 4.1.1 configuration\_definitions

The configuration\_definitions UoF specifies the concepts for keeping high level records and information relating to product identification and its usage context. Concepts such as associating the product to contracts/projects and assigning the ownership of product are supported. The configuration\_definitions UoF also supports the life cycle identification of a mechanical product and whether a mechanical product represents a conceptual, designed, planned or a real thing.

##### NOTES

- 1 - Product configuration (see 3.8.123) is independent of its definitions' configuration (see 3.8.44). However, it may reference data relating to definitions' configuration.
- 2 - The tracking of mechanical product status within its lifecycle is within the scope of this UoF.
- 3 - The concepts required to uniquely identify a mechanical product and its classification are out of scope of this UoF.
- 4 - The concepts required to support configuration management activities such as versioning, change control and approval of version or change are out of scope of this UoF.

The following application objects are used by the configuration\_definitions UoF:

- Configuration\_definition;
- Product\_context;
- Product\_identification;
- Product\_status.

#### 4.1.2 cranes

The cranes UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a crane.

##### NOTES

- 1 - This UoF inherits all the generic crane-related definitions.
- 2 - This UoF is always used in connection with other UoFs which associate description, approval details, identification data and other definitions to cranes.
- 3 - The information on systems, equipments and components which are part of a crane is outside the scope of this UOF.

The following application objects are used by the cranes UoF:

- Crane;
- Crane\_ambient\_condition;
- Crane\_composition;
- Crane\_design\_characteristic;
- Crane\_general\_characteristic;
- Crane\_load\_characteristic;
- Crane\_overall\_dimension;
- Crane\_stability\_data;

### 4.1.3 diesel\_engines

The diesel\_engines UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a diesel engine.

#### NOTES

- 1 - This UoF inherits all the generic diesel engine related definitions.
- 2 - This UoF is always used in connection with other UoFs which associate description, approval details, identification data and other definitions to diesel engines.
- 3 - The information on systems, equipments and components which are part of a diesel engine is out of scope of this UoF.

The following application objects are used by the diesel\_engines UoF:

- Diesel\_engine;
- Diesel\_engine\_design\_characteristic;
- Diesel\_engine\_general\_characteristic;
- Diesel\_engine\_operational\_characteristic;
- Exhaust\_emission;
- Fluid\_operational\_data.

### 4.1.4 external\_references

The external\_references UoF specifies an external reference mechanism to assign additional documentation in electronic or non-electronic form to the product, task/activity or definitions. The external\_references UoF also facilitates access to information, standard or non-standard, on ship mechanical systems that are outside the scope of this part of ISO 10303.

#### NOTES

- 1 - All types of user manuals, computer files, catalogues, reports, books and so on are considered as external documents and are in the scope of this UoF.
- 2 - The referencing of external databases and data libraries, standard or non-standard, are in the scope of this UoF.

The following application objects are used by the external\_references UoF:

- Document;
- Document\_reference;
- External\_instance\_reference;
- External\_mechanical\_product\_definition;
- External\_reference;
- External\_reference\_inside\_source;
- GUID.

#### 4.1.5 gas\_material\_properties

The gas\_material\_properties UoF specifies the framework for grouping of the gas properties into physical, chemical and other types of properties and their association to a gaseous material.

##### NOTES

- 1 - The reference pressure and temperature for gas properties are specified in this UoF.
- 2 - The scope of this UoF covers gaseous fuels, gaseous working fluids and gaseous ambient conditions.

The following application objects are used by the gas\_material\_properties UoF:

- Gas\_chemical\_property;
- Gas\_material\_property;
- Gas\_physical\_property.

#### 4.1.6 lifting equipments

The lifting equipments UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a lifting equipment.

##### NOTES

- 1 - This UoF inherits all the lifting equipment related generic definitions. .
- 2 - This UoF is always used in association with other UoFs which associate description, approval details, identification data and other definitions to lifting equipments.

The following application objects are used by the lifting equipments UoF:

- Lifting\_equipment;
- Lifting\_equipment\_design\_characteristic.

#### 4.1.7 liquid\_material\_properties

The liquid\_material\_properties UoF specifies the framework for grouping of the liquid properties into physical, chemical and other types of properties and their association to a liquid material.

##### NOTES

- 1 - The reference pressure and temperature for liquid properties are specified in this UoF.
- 2 - The scope of this UoF covers liquid fuels, liquid working fluids and liquid ambient conditions.

The following application objects are used by the liquid\_material\_properties UoF:

- Liquid\_chemical\_property;
- Liquid\_fluid\_impurity;
- Liquid\_impurity;
- Liquid\_material\_property;
- Liquid\_physical\_property;
- Material\_property;
- Metallic\_impurity.

#### 4.1.8 local\_co\_ordinate\_systems

The local\_co\_ordinate\_systems UoF specifies location of a mechanical product within the coordinate system.

The following application objects are used by the local\_co\_ordinate\_systems UoF:

- Local\_co\_ordinate\_system.

#### 4.1.9 machineries

The machineries UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a machinery (see 3.8.88).

##### NOTES

1 - This UoF inherits all the machinery-related generic definitions.

2 - This UoF is always used in connection with other UoFs which associate description, approval details, identification data and other definitions to a machinery.

The following application objects are used by the machineries UoF:

- Machinery;
- Machinery\_ambient\_condition;
- Machinery\_design\_characteristic;
- Machinery\_general\_characteristic;
- Machinery\_operational\_characteristic;
- Operating\_point.

#### 4.1.10 maintenance\_tasks

The maintenance\_tasks UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a maintenance task.

##### NOTES

1 - This UoF inherits all the maintenance task related definitions.

2 - This UoF is always used in association with generic task related UoFs which associate description, approval details, identification data and other definitions to a maintenance task.

The following application objects are used by the maintenance\_tasks UoF:

- Maintenance\_configuration\_data;
- Maintenance\_human\_resource;
- Maintenance\_procedure;
- Maintenance\_result;
- Maintenance\_schedule;
- Maintenance\_spare\_part;
- Maintenance\_task;
- Maintenance-tool.

#### 4.1.11 measure\_with\_units

The measure\_with\_units UoF specifies the concept for representing measures for physical quantities together with their units.

The following application objects are used by the measure\_with\_units UoF:

- Density;
- Dilatation;
- Energy\_per\_mass;
- Heat\_capacity;
- Inertia\_moment;
- Length;
- Mass;
- Measure\_with\_unit;
- Plane\_angle;
- Power;
- Pressure;
- Ratio;
- Rotational\_speed;
- Speed;
- Stress;
- Surface\_tension;
- Temperature;
- Thermal\_conductivity;
- Time;
- Torque;
- Viscosity.

#### 4.1.12 mechanical\_machineries

The mechanical\_machineries UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a mechanical machinery (see 3.8.101).

##### NOTES

1 - This UoF inherits all the mechanical machinery related definitions.

2 - This UoF is always used in association with other UoFs which associate description, approval details, identification data and other definitions to a mechanical machinery.

The following application objects are used by the mechanical\_machineries UoF:

- Mechanical\_machinery;
- Mechanical\_machinery\_composition;
- Mechanical\_machinery\_identification;
- Rotating\_machinery.

#### 4.1.13 mechanical\_product\_anomalies

The mechanical\_product\_anomalies UoF specifies the concept and framework for type hierarchy and grouping of different types of engineering information relating to product anomaly (see 3.8.6).

##### NOTES

- 1 - The definition of tasks in order to rectify the product anomaly is outside the scope of this UoF:
- 2 - The classification and identification of type of anomaly are within the scope of this UoF.

The following application objects are used by the mechanical\_product\_anomalies UoF;

- Design\_anomaly;
- Failure;
- Failure\_effect;
- Fault;
- Product\_anomaly.

#### 4.1.14 mechanical\_product\_components

The mechanical\_product\_components UoF specifies the concept for defining the type hierarchy and classification of the mechanical components not defined in other UoFs.

##### NOTES

- 1 - This UoF does not provide any extra information about the mechanical components other than their existence and type of component.
- 2 - This UoF is always used in connection with other UoFs which associate description, approval, identification data and other definitions to a mechanical component.

The following application objects are used by the mechanical\_product\_components UoF:

- Bearing;
- Bedplate;
- Bolt;
- Connecting\_component;
- Connector\_component;
- Mechanical\_component;
- Mechanical\_product\_component;
- Piping\_component;
- Pipe;
- Piping\_component;
- Piston;
- Rotating\_component;
- Shaft;

— Structural\_connector.

#### 4.1.15 mechanical\_product\_connections

The mechanical\_product\_connections UoF specifies the concept for defining the physical connections between mechanical products.

##### NOTES

1 - This UoF is used to specify the type of connection as well as the engineering specifications for the connection.

2 - Identification of all the mechanical products which take part in realising the physical connection is in the scope of this UoF.

The following application objects are used by the mechanical\_product\_connections UoF:

- Connection\_characteristic;
- Connection\_specification;
- Electrical\_connection;
- Mechanical\_connection;
- Mechanical\_product\_connection;
- Piping\_connection;
- Product\_connection;
- Structural\_connection.

#### 4.1.16 mechanical\_product\_definitions

The mechanical\_product\_definitions UoF specifies the high level concept and framework for type hierarchy and grouping of all the engineering information (descriptions and properties) which are attributable to mechanical products.

##### NOTES

1 - The information in the form of documentation is within the scope of this UoF.

2 - The information on identifying a mechanical product, its structure and its configuration are outside the scope of this UoF.

3 - The product data and information needed in support of or resulting from lifecycle engineering activities and tasks, carried out in relation to mechanical products, are outside the scope of this UoF.

The following application objects are used by the mechanical\_product\_definitions UoF:

- Ambient\_condition;
- Definition;
- Design\_characteristic;
- Engineering\_analysis\_definition;
- Functional\_characteristic;
- Functional\_definition;
- Gas;
- Geometric\_definition;
- Liquid;



- Mass\_weight\_inertia;
- Operational\_characteristic;
- Overall\_dimension;
- Physical\_definition;
- Product\_material;
- Tolerance.

#### **4.1.17 mechanical\_product equipments**

The `mechanical_product equipments` specifies the high-level concept for representing the generic class of equipment (see 3.8.58) and association of the relevant definitions (see 3.8.43) to this class.

##### NOTES

- 1 - This UoF is always used in connection with other UoFs which associates definitions to equipment.
- 2 - This UoF is used by all subtypes of equipment.

The following application objects are used by the `mechanical_product equipments` UoF:

- `MP_equipment_general_characteristic`;
- `MP_equipment_identification`;
- `MP_equipment`.

#### **4.1.18 mechanical\_product\_general\_characteristics**

The `mechanical_product_general_characteristics` UoF specifies the concept for collecting all the information which are attributable to general characteristics (see 3.8.77) of a mechanical product.

##### NOTES

- 1 - This UoF collects and references general data which are defined in other UoFs.
- 2 - This UoF is always used in connection with other UoFs.

The following application objects are used by the `mechanical_product_general_characteristics` UoF:

- `Mechanical_product_general_characteristic`.

#### **4.1.19 mechanical\_product\_representations**

The `mechanical_product_representations` UoF specifies the concept for the representation of mechanical product's detailed geometric definitions in the form of shape representation (solid model) and drawing. The `mechanical_product_representations` UoF also facilitates the exchange of identification information on drawings, in addition to the exchange of drawing itself.

##### NOTES

- 1 - Definition of the internal geometry of mechanical products is outside the scope of this UoF.
- 2 - Information on drawings for identification purposes and association of a drawing to a mechanical product is within the scope of this UoF.

The following application objects are used by the mechanical\_product\_representations UoF:

- Approval\_details;
- Drawing\_configuration;
- Mechanical\_product\_drawing;
- Mechanical\_product\_representation;
- Mechanical\_product\_shape\_representation.

#### 4.1.20 mechanical\_product\_structures

The mechanical\_product\_structures UoF defines the internal composition (see 3.8.26), external participation (being part of something else), connectivity, position and orientation of mechanical products. The mechanical\_product\_structures UoF provides the ability to exchange description of the position of a mechanical product and its arrangement.

##### NOTES

- 1 - This UoF is always used in conjunction with the mechanical\_products UoF for which composition, participation, connectivity and placement need to be defined.
- 2 - The placement and position of the mechanical product may be something such as a compartment or side of a ship.
- 3 - The precise position of the mechanical products in terms of ship co-ordinate system is within the scope of this UoF.
- 4 - The composition of mechanical products will be supported in terms of mechanical product hierarchical decomposition, as developed and documented within this part of ISO 10303 (see Annex M).
- 5 - The connectivity of mechanical product to its boundary mechanical products and ship structures are facilitated by inclusion of connectors (see 3.8.35) within the internal composition of mechanical products. However, the definition of a physical connection (see 3.8.34) is outside the scope of this UoF and is supported by the mechanical\_product\_connections UoF (see 4.1.15).

The following application objects are used by the mechanical\_product\_structures UoF:

- Product\_assembly;
- Product\_composition;
- Product\_connectivity;
- Product\_participation;
- Product\_placement;
- Product\_structure\_definition;
- Ship\_space;

#### 4.1.21 mechanical\_product\_systems

The mechanical\_product\_systems UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a mechanical system (see 3.8.104).

##### NOTES

- 1 - This UoF inherits all the generic system's related definitions.

2 - This UoF is always used in association with other UoFs which associate description, approval details, identification data and other definitions to a mechanical system.

The following application objects are used by the mechanical\_product\_systems UoF:

- Control\_and\_monitoring\_system;
- Electrical\_system;
- Manoeuvring\_system;
- Mechanical\_system;
- Mechanical\_transmission\_system;
- MP\_piping\_system;
- Propulsion\_system;
- Steam\_generation\_system.

#### 4.1.22 mechanical\_products

The mechanical\_products UoF specifies the high level concept for defining the type hierarchy and classification of mechanical products (see 3.8.103) in a compatible way to other ship APs.

##### NOTES

1 - This UoF does not provide any extra information about the mechanical product other than its existence, context within which it is used and its functionality.

2 - This UoF is always used in connection with other UoFs which associate description, approval, identification data and other definitions to a mechanical product.

The following application objects are used by the mechanical\_products UoF:

- Definable\_object;
- Item;
- Item\_relationship;
- Item\_structure;
- Mechanical\_product;
- Mechanical\_product\_relationship.

#### 4.1.23 other equipments

The other equipments UoF specifies the concept for defining the type hierarchy and classification of those equipments (see 3.8.58) which have not been defined in other UoFs.

##### NOTES

1 - This UoF does not provide any extra information about the mechanical equipments other than their existence and type of equipment.

2 - This UoF is always used in connection with other UoFs which associate description, approval, identification data and other definitions to the mechanical equipments UoF.

The following application objects are used by the other equipments UoF.

- Analyser;
- Control\_equipment;

- Coupling;
- Electrical\_equipment;
- Gear\_box;
- Heat\_exchanger;
- Mechanical\_equipment;
- Piping\_equipment;
- Process\_equipment;
- Transformer;
- Valve.

#### 4.1.24 other\_tasks

The other\_tasks UoF specifies the concept for defining the high-level information relating to tasks (see 3.8.155) which have not been defined in other UoFs.

##### NOTES

- 1 - This UoF does not provide any extra information about a task other than its existence and its type.
- 2 - This UoF is normally used in connection with other task-related UoFs which associate description, approval data and other definitions to the tasks.

The following application objects are used by the other\_tasks UoF:

- Analysis\_task;
- Design\_task;
- Operation\_task;
- Other\_task;
- Survey\_inspection\_task.

#### 4.1.25 part41\_resources

The part41\_resources UoF specifies all the application objects which are in ISO10303-41 and are used by this part of ISO 10303.

The following application objects are used by the part41\_resources UoF:

- Address;
- Date;
- Date\_and\_time;
- Label;
- Organization;
- Organizational\_project;
- Person;
- Person\_and\_organization;
- Text.

#### 4.1.26 part42\_resources

The part42\_resources UoF specifies all the application objects which are in ISO10303-42 and are used by this part of ISO 10303.

The following application objects are used by the part42\_resources UoF:

- Cartesian\_point;
- Direction;
- Geometric\_representation\_item;
- Solid\_model;
- Vector.

#### **4.1.27 RAM\_characteristics**

The RAM\_characteristics UoF specifies the concept for collecting the data and information relating to mechanical product's RAM characteristics (see 3.8.132).

##### **NOTES**

- 1 - The procedures for calculating or recording the RAM-related data are outside the scope of this UoF.
- 2 - This UoF is closely related to product\_anomalies UoF.

The following application objects are used by the RAM\_characteristics UoF:

- Availability;
- Maintainability;
- RAM\_characteristic;
- Reliability.

#### **4.1.28 reciprocating\_machineries**

The reciprocating\_machineries UoF specifies the concept for associating the relevant definitions (see 3.8.43) to a reciprocating machinery (see 3.8.133).

##### **NOTES**

1. This UoF inherits all the reciprocating machinery related generic definitions.
2. This UoF is always used in association with other UoFs which associate description, approval details, identification data and other definitions to a reciprocating machinery.

The following application objects are used by the reciprocating\_machineries UoF:

- Reciprocating\_machinery;
- Reciprocating\_machinery\_composition;
- Reciprocating\_machinery\_general\_characteristic;
- Reciprocating\_machinery\_overall\_dimension.

#### **4.1.29 screw\_propellers**

The screw\_propellers UoF specifies the concept for associating the relevant definitions (see 3.8.43) to screw propellers (see 3.8.136).

#### NOTES

- 1 - This UoF inherits all the screw propeller related generic definitions.
- 2 - This UoF is always used in connection with other UoFs which associate description, approval details, identification data and other definitions to screw propellers .
- 3 – The information on systems, equipments and components which are part of a screw propeller is outside the scope of this UoF.

The following application objects are used by the screw\_propellers UoF:

- Power\_speed\_pitch\_point;
- Screw\_propeller;
- Screw\_propeller\_composition;
- Screw\_propeller\_design\_characteristic;
- Screw\_propeller\_general\_characteristic;
- Screw\_propeller\_mass\_weight\_inertia;
- Screw\_propeller\_operational\_characteristic;
- Screw\_propeller\_overall\_dimension.

### 4.1.30 ships

The ships UoF specifies the information required to describe the ship. All ship product data are defined independent of the ship and have a reference to it. The ships UoF describes the essential information to permit that reference. This UoF is common to ship related application protocols.

The following application objects are used by the ships UoF:

- Ship.

### 4.1.31 solid\_material\_properties

The solid\_material\_properties UoF specifies the material properties and their association to a solid material.

The following application objects are used by the solid\_material\_properties UoF:

- Element\_content;
- Solid\_material\_property.

### 4.1.32 task\_definitions

The task\_definitions UoF specifies the high level concept and framework for type hierarchy and grouping of all the data and information which are attributable to tasks (see 3.8.155).

#### NOTES

- 1 - The information in the form of documentation is in the scope of this UoF.

2 - The information relating to task configuration, procedures, schedules and required resources are in the scope of this UoF.

The following application objects are used by the task\_definitions UoF:

- Human\_resource;
- Spare\_part;
- Task\_approval;
- Task\_configuration;
- Task\_definition;
- Task\_other\_definition;
- Task\_other\_resource;
- Task\_procedure;
- Task\_resource;
- Task\_result;
- Task\_schedule;
- Tool.

### 4.1.33 tasks

The tasks UoF specifies the concept for defining the high-level information relating to tasks (see 3.8.155). Concepts for relating tasks to each other and identification of major aspects of relationship are also supported by the tasks UoF.

#### NOTES

- 1 - This UoF does not provide any extra information about a task other than its existence, its identification and the identification of the mechanical products which the task relates to.
- 2 - This UoF is normally used in connection with other task-related UoFs which associate description, approval and definitions to the tasks.

The following application objects are used by the tasks UoF:

- Task;
- Task\_relationship.

### 4.1.34 time\_and\_events

The time\_and\_events UoF specifies the concept for describing the events and their authorisation and approval. All the events which take place during the various stages of ship life cycle are in the scope of the time\_and\_events UoF

The following application objects are used by the time\_and\_events UoF:

- Approval\_event;
- Event;
- Time\_period;
- Time\_schedule.

## 4.2 Application Objects

This subclause specifies the application objects for the ship mechanical systems application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The application objects and their definitions are given below.

### 4.2.1 Address

An Address specifies postal data associated with a person or organisation. It is used as defined in ISO 10303-41.

### 4.2.2 Ambient\_condition

An Ambient\_condition specifies and collects data relating to the ambient conditions of a mechanical product.

The data associated with an Ambient\_condition are the following:

- ambient\_fluid;
- ambient\_pressure;
- ambient\_temperature;
- defined\_for;
- environment.

#### 4.2.2.1 ambient\_fluid

The ambient\_fluid attribute specifies the type of the ambient fluid for the mechanical product. An ambient\_fluid can be either a Gas (see 4.2.62) or a Liquid (see 4.2.81).

#### 4.2.2.2 ambient\_pressure

The ambient\_pressure attribute specifies the pressure of the ambient fluid.

#### 4.2.2.3 ambient\_temperature

The ambient\_temperature attribute specifies the temperature of the ambient fluid.

#### 4.2.2.4 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which ambient condition data are defined.

#### 4.2.2.5 environment

The environment attribute specifies and describes the major aspects of the environment within which a mechanical product operates.



### 4.2.3 Analyser

An Analyser is a type of Control\_equipment (see 4.2.18) and specifies the data representation concept for all the analysers which need to be defined.

The data associated with an analyser are the following:

- analyser\_type.

The analyser\_type attribute specifies the type of analyser.

### 4.2.4 Analysis\_task

An Analysis\_task is a type of Task (see 4.2.189) and specifies the concept for collecting data which are attributable to an analysis task.

The data associated with an Analysis\_task are the following:

- type\_of\_task.

The type\_of\_task attribute specifies the type of analysis task in a text format.

### 4.2.5 Approval\_details

The Approval\_details is a type of Approval\_event (see 4.2.6) and specifies the approval information for a drawing.

### 4.2.6 Approval\_event

An Approval\_event is a type of Event (see 4.2.50) and specifies an approval or authorisation event.

The data associated with an Approval\_event are the following:

- result.

The result attribute specifies the approval status the event leads to.

The value of result shall be one of the following:

- approved;
- noted;
- rejected;
- unapproved.

**4.2.6.1 approved:** a version of the Definition has been approved for use in a later lifecycle phase.

**4.2.6.2 noted:** the need for an approval decision for a version of the Definition has been identified.

**4.2.6.3 rejected:** the version of the Definition has been rejected for use in a later lifecycle phase.

**4.2.6.4 unapproved:** the approval status of a version of the Definition is in the process of being reviewed by the organization.

## 4.2.7 Availability

An Availability specifies the data which are attributable to availability performance of a mechanical product.

The data associated with an Availability are the following:

- duration\_of\_down-time;
- duration\_of\_up\_time;
- mean\_availability;
- total\_duration.

### 4.2.7.1 duration\_of\_down\_time

The duration\_of\_down\_time attribute specifies the expected duration for an equipment to be in a downstate (see 3.7).

### 4.2.7.2 duration\_of\_up\_time

The duration\_of\_up\_time attribute specifies the expected duration for an equipment to be in an upstate (see 3.7).

### 4.2.7.3 mean\_availability

The mean\_availability attribute specifies the mean availability (see 3.7) for an equipment.

### 4.2.7.4 total\_duration

The total\_duration attribute specifies the total duration of time for which availability performance information is specified.

## 4.2.8 Bearing

A Bearing is a type of Mechanical\_component (see 4.2.105) which specifies the high level concept for all the bearings which need to be defined or described.

The data associated with a Bearing are the following:

- bearing\_type

The bearing\_type attribute specifies the type of bearing.

The value of bearing\_type shall be one of the following:

- big\_end\_bearing;
- shaft\_bearing;
- small\_end\_bearing;
- user\_defined\_bearing\_type.

**4.2.8.1 big\_end\_bearing:** the descriptor which specifies that the bearing is a big end bearing of a diesel engine.

**4.2.8.2 shaft\_bearing:** the descriptor which specifies that the bearing is of type shaft bearing.

**4.2.8.3 small\_end\_bearing:** the descriptor which specifies that the bearing is of type small end bearing.

**4.2.8.4 user\_defined\_bearing\_type:** the descriptor, set by the user, which specifies the type of bearing if different from the other options.

## 4.2.9 Bedplate

A Bedplate is a type of Structural\_connector (see 4.2.186) and specifies the data representation concept for all the bedplates which need to be defined.

The data associated with a Bedplate are the following:

- bedplate\_type.

The bedplate\_type attribute specifies the type of bedplate in text format.

## 4.2.10 Bolt

A Bolt is a type of Connecting\_component (see 4.2.13) which specifies the data representation concept for all the bolts which need to be defined.

The data associated with a Bolt are the following:

- bolt\_type.

The bolt\_type attribute specifies the type of bolt in text format.

## 4.2.11 Cartesian\_point

A Cartesian\_point specifies a point defined by its coordinates in a rectangular Cartesian coordinate system, or in a parameter space. The entity is defined in a one, two or three-dimensional space as determined by the number of coordinates in the list. It is used as defined in ISO 10303-42.

## 4.2.12 Configuration\_definition

A Configuration\_definition is a type of Definition (see 4.2.30) and specifies the data relating to the configuration (see 3.8.32) of a mechanical product.

The data associated with a Configuration\_definition are the following:

- configuration\_id

The configuration\_id attribute specifies the identification of the mechanical product configuration in the form of a label.

### 4.2.13 Connecting\_component

A Connecting\_component is a type of Mechanical\_product\_component (see 4.2.112) and specifies the high level data representation concept for all types of connecting components (see 3.8.33) which need to be defined.

The data associated with a Connecting\_component are the following:

- connecting\_component\_type;

The connecting\_component\_type attribute specifies the type of the connecting component.

The value of the connecting\_component shall be one of the following:

- bolt;
- chock;
- nut;
- pin;
- rod;
- seal;
- user\_defined\_connecting\_component.

**4.2.13.1 bolt:** the descriptor which specifies that the connecting component is of type bolt.

**4.2.13.2 chock:** the descriptor which specifies that the connecting component is of type chock.

**4.2.13.3 nut:** the descriptor which specifies that the connecting component is of type nut.

**4.2.13.4 pin:** the descriptor which specifies that the connecting component is of type pin.

**4.2.13.5 rod:** the descriptor which specifies that the connecting component is of type rod.

**4.2.13.6 seal:** the descriptor which specifies that the connecting component is of type seal.

**4.2.13.7 user\_defined\_connecting\_component:** the descriptor, set by the user, which specifies the type of the connecting component if different from the other options.

### 4.2.14 Connection\_characteristic

A Connection\_characteristic specifies all the information which defines the functional and operational characteristics of a connection (see 3.8.34).

The data associated with a Connection\_characteristic are the following:

- connection\_functional\_characteristics;
- connection\_operational\_characteristics.

#### **4.2.14.1 connection\_functional\_characteristics**

The connection\_functional\_characteristics attribute specifies all the information which relates to functional design aspects of a connection in the form of documents.

#### **4.2.14.2 connection\_operational\_characteristics**

The connection\_operational\_characteristics attribute specifies all the information which relates to operational aspects of a connection in the form of documents.

### **4.2.15 Connection\_specification**

A Connection\_specification specifies all the information which relates to non-functional aspects of a connection (see 3.8.34) including manufacturing and installation aspects and geometric definitions.

The data associated with a Connection\_specification are the following:

- connection\_procedure;
- engineering\_definitions;
- geometric\_definitions.

#### **4.2.15.1 connection\_procedure**

The connection\_procedure attribute specifies the procedure for assembly, installation and disassembly of the connection in the form of reference to documents.

#### **4.2.15.2 engineering\_definitions**

The engineering\_definitions attribute specifies all the engineering data relating to the connection in the form of reference to documents.

#### **4.2.15.3 geometric\_definitions**

The geometric\_definitions attribute specifies details of geometric specifications including dimensional drawings in the form of reference to documents.

### **4.2.16 Connector\_component**

A Connector\_component is a type of Mechanical\_product\_component (see 4.2.112) that specifies the high level concept for data representation for all the connectors (see 3.8.35) which need to be defined.

The data associated with a Connector\_component are the following:

- connector\_component\_type.

The connector\_component\_type attribute specifies the type of connector component.

The value of the `connector_component_type` shall be one of the following:

- `electrical_connector`;
- `mechanical_connector`;
- `piping_connector`;
- `structural_connector`;
- `user_defined_connector_type`.

**4.2.16.1 electrical\_connector:** the descriptor which specifies that the connector component is of type electrical connector.

**4.2.16.2 mechanical\_connector:** the descriptor which specifies that the connector component is of type mechanical connector.

**4.2.16.3 piping\_connector:** the descriptor which specifies that the connector component is of type piping connector.

**4.2.16.4 structural\_connector:** the descriptor which specifies that the connector component is of type structural connector.

**4.2.16.5 user\_defined\_connector\_type:** the descriptor, set by the user, which specifies the type of connector component if different from the other options.

## 4.2.17 Control\_and\_monitoring\_system

A `Control_and_monitoring_system` is a type of `Mechanical_system` (see 4.2.119) which specifies the high level concept for all the control and monitoring systems (see 3.8.38) which need to be defined or described.

The data associated with a `Control_and_monitoring_system` are the following:

- `type_of`.

The `type_of` attribute specifies the type of control and monitoring system.

## 4.2.18 Control\_equipment

A `Control_equipment` is a type of `MP_equipment` (see 4.2.122) which specifies the high level concept for all the control equipment (see 3.8.39) which needs to be defined.

The data associated with a `Control_equipment` are the following:

- `control_equipment_type`.

The `control_equipment_type` attribute specifies the type of control equipment.

The value of the `control_equipment_type` shall be one of the following:

- `actuator`;

- analyser;
- signal\_conditioner;
- user\_defined.

**4.2.18.1 actuator:** the descriptor which specifies the control equipment is an actuator.

**4.2.18.2 analyser:** the descriptor which specifies that control equipment is an analyser.

**4.2.18.3 signal\_conditioner:** the descriptor which specifies that control equipment is a signal\_conditioner.

**4.2.18.4 user\_defined:** the descriptor, set by the user, which specifies the type of control equipment if different from the other options.

## 4.2.19 Coupling

A coupling is a type of Mechanical\_equipment (see 4.2.107) and specifies the data representation concept for all the couplings which need to be defined.

The data associated with a Coupling are the following:

- coupling\_type;

The coupling\_type attribute specifies the type of coupling in a text format.

## 4.2.20 Crane

A Crane is a type of Lifting\_equipment (see 4.2.79) and specifies the concept for all the cranes which need to be defined.

The data associated with a Crane are the following:

- crane\_type.

The crane\_type attribute specifies the type of crane.

The value of crane\_type shall be one of the following:

- deck\_crane;
- user\_defined\_crane.

**4.2.20.1 deck\_crane:** the descriptor which specifies that the crane is of type deck crane.

**4.2.20.2 user-defined\_crane:** the descriptor, set by the user, if type of crane is different from the other options.

## 4.2.21 Crane\_ambient\_condition

A Crane\_ambient\_condition is a type of Ambient\_condition (see 4.2.2) and specifies the ambient conditions for a crane.

The data associated with a Crane\_ambient\_condition are the following:

- defined\_for;
- wind\_speed.

#### **4.2.21.1 defined\_for**

The defined\_for attribute specifies a set of one to many cranes for which the definitions are defined.

#### **4.2.21.2 wind\_speed**

The wind\_speed attribute specifies the wind speed for which the crane has been designed.

### **4.2.22 Crane\_composition**

A Crane\_composition is a type of Product\_composition (see 4.2.148) and specifies the high level concept for all the product composition (see 3.8.26) data which are attributable to all types of cranes.

The data associated with a Crane\_composition are the following:

- defined\_for;
- equipment\_list.

#### **4.2.22.1 defined\_for**

The defined\_for attribute specifies a set of one to many cranes for which the definitions are defined.

#### **4.2.22.2 equipment\_list**

The equipment\_list attribute specifies the particulars of each equipment which is part of a crane. The equipment\_list is a DERIVED parameter from higher level product structure definitions.

### **4.2.23 Crane\_design\_characteristic**

A Crane\_design\_characteristic is a type of Lifting\_equipment\_design\_characteristic (see 4.2.80) and specifies the functional design data which are attributable to all types of cranes.

The data associated with a Crane\_design\_characteristic are the following:

- braking\_time;
- defined\_for;
- hoisting\_speed\_1;
- hoisting\_speed\_2;
- hoisting\_speed\_3;
- lifting\_height;
- luffing\_time;



- slewing\_speed\_single;
- slewing\_speed\_twin;
- stability\_data.

#### **4.2.23.1 braking\_time**

The braking\_time attribute specifies the crane hoisting braking time.

#### **4.2.23.2 defined\_for**

The defined\_for attribute specifies a set of one to many cranes for which the definitions are defined.

#### **4.2.23.3 hoisting\_speed\_1**

The hoisting\_speed\_1 attribute specifies the crane hoisting speed level 1.

#### **4.2.23.4 hoisting\_speed\_2**

The hoisting\_speed\_2 attribute specifies the crane hoisting speed level 2.

#### **4.2.23.5 hoisting\_speed\_3**

The hoisting\_speed\_3 attribute specifies the crane hoisting speed level 3.

#### **4.2.23.6 lifting\_height**

The lifting\_height attribute specifies the crane's lifting height.

#### **4.2.23.7 luffing\_time**

The luffing\_time attribute specifies the crane luffing time for raising the jib from its minimum angle to its maximum angle.

#### **4.2.23.8 slewing\_speed\_single**

The slewing\_speed\_single attribute specifies the crane slewing speed for a single system.

#### **4.2.23.9 slewing\_speed\_twin**

The slewing\_speed\_twin attribute specifies the crane slewing speed for a twin system.

#### **4.2.23.10 stability\_data**

The stability\_data attribute specifies the crane-related stability data by referencing the Crane\_stability\_data (see 4.2.27) application object.

### **4.2.24 Crane\_general\_characteristic**

A Crane\_general\_characteristic is a type of MP\_equipment\_general\_characteristic (see 4.2.123) and specifies the high level concept for all the general characteristics data which are attributable to all types of cranes.

The data associated with a Crane\_general\_characteristic are the following:

- defined\_for;
- jib\_parking\_arrangements.

#### **4.2.24.1 defined\_for**

The defined\_for attribute specifies a set of one to many cranes for which the definitions are defined.

#### **4.2.24.2 jib\_parking\_arrangements**

The jib\_parking\_arrangements attribute specifies the parking arrangement for a jib when the crane is not in use.

### **4.2.25 Crane\_load\_characteristic**

A Crane\_load\_characteristic is a type of Engineering\_analysis\_definition (see 4.2.49) and specifies the principal forces/loads which act on a crane.

The data associated with a Crane\_load\_characteristic are the following:

- defined\_for;
- forces\_due\_to\_wind;
- forces\_dynamic;
- forces\_ship\_inclination;
- loads\_dead;
- loads\_live;
- loads\_on\_platform;
- loads\_snow\_and\_ice;

#### **4.2.25.1 defined\_for**

The defined\_for attribute specifies a set of one to many cranes for which the load characteristics are defined.

#### **4.2.25.2 forces\_due\_to\_wind**

The forces\_due\_to\_wind attribute specifies the total force acting on the crane due to wind.

#### **4.2.25.3 forces\_dynamic**

The forces\_dynamic attribute specifies the total force acting on the crane due to crane dynamics.

#### **4.2.25.4 forces\_ship\_inclination**

The `forces_ship_inclination` attribute specifies the total force acting on the crane due to the ship heel and trim.

#### **4.2.25.5    `loads_dead`**

The `loads_dead` attribute specifies the total force acting on the crane due to the crane weight.

#### **4.2.25.6    `loads_live`**

The `loads_live` attribute specifies the total force acting on the crane due to the hoisting load.

#### **4.2.25.7    `loads_on_platform`**

The `loads_on_platform` attribute specifies the total force acting on the ship deck supporting the crane.

#### **4.2.25.8    `loads_snow_and_ice`**

The `loads_snow_and_ice` attribute specifies the total expected maximum force due to snow and ice.

### **4.2.26    `Crane_overall_dimension`**

A `Crane_overall_dimension` is a type of `Overall_dimension` (see 4.2.132) and collects all the overall dimensions which are attributable to all types of cranes.

The data associated with a `Crane_overall_dimension` are the following:

- `defined_for`;
- `jib_angle_max`;
- `jib_angle_min`;
- `jib_radius_max`;
- `jib_radius_min`.

#### **4.2.26.1    `defined_for`**

The `defined_for` attribute specifies a set of one to many cranes for which the definitions are defined.

#### **4.2.26.2    `jib_angle_max`**

The `jib_angle_max` attribute specifies the maximum angle of elevation of the crane jib.

#### **4.2.26.3    `jib_angle_min`**

The `jib_angle_min` attribute specifies the minimum angle of elevation of the crane jib.

#### **4.2.26.4    `jib_radius_max`**

The `jib_radius_max` attribute specifies the maximum radius of the crane jib from the slewing axis.

#### 4.2.26.5 jib\_radius\_min

The jib\_radius\_min attribute specifies the minimum radius of the crane jib.

### 4.2.27 Crane\_stability\_data

A Crane\_stability\_data specifies the data which define the stability characteristics of a crane.

The data associated with a Crane\_stability\_data are the following:

- overturning\_moment;
- stability\_moment.

#### 4.2.27.1 overturning\_moment

The overturning\_moment attribute specifies the moment which causes crane overturning.

#### 4.2.27.2 stability\_moment

The stability\_moment attribute specifies the stability moment.

### 4.2.28 Date\_and\_time

A Date\_and\_time specifies the combined calendar date and the day time. It is used as defined in ISO 10303-41.

### 4.2.29 Definable\_object

A Definable\_object is the supertype for all the objects which needs to be defined.

The data associated with a Definable\_object are the following:

- definitions.

The definitions attribute references a set of zero to many Definitions (see 4.2.30) which relate to a Definable\_object.

### 4.2.30 Definition

A Definition is the supertype for all kinds of product's definitions (see 3.8.43). Within this part of ISO 10303, each Definition is either a Physical\_definition (see 4.2.135), a Functional\_definition (see 4.2.61), a Configuration\_definition (see 4.2.12), an Engineering\_analysis\_definition (see 4.2.49), a Product\_anomaly (see 4.2.146), Mechanical\_product\_general\_characteristic (see 4.2.115), or a Product\_structure\_definition (see 4.2.157).

The data associated with a Definition are the following:

- defined\_for;
- local\_units;

– version\_id.

#### **4.2.30.1 defined\_for**

The defined\_for specifies the definable objects which are defined by Definition. There may be more than one defined\_for for a Definition.

#### **4.2.30.2 local\_units**

The local\_units attribute specifies the units that Definition makes use of, if different from the ones globally defined for the ship. There may be more than one local\_units for a Definition.

#### **4.2.30.3 version\_id**

The version\_id provides simple version control. The version\_id need not be specified for a particular Definition.

### **4.2.31 Density**

A Density is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the density of a material.

The data associated with a Density are the following:

– density\_unit.

The density\_unit attribute specifies all the units which can be used to specify density.

### **4.2.32 Design\_anomaly**

A Design\_anomaly is a type of Product\_anomaly (see 4.2.146) which specifies the data which are attributable to design anomaly (see 3.8.6) of a mechanical product.

The data associated with a Design\_anomaly are the following:

- design\_anomaly\_type

The design\_anomaly\_type attribute specifies a descriptor for the type of design anomaly in textual format.

### **4.2.33 Design\_characteristic**

A Design\_characteristic is a type of Functional\_characteristic (see 4.2.60) and specifies the high level concept for all the definitions (see 3.8.43) which are attributable to the functional design of a mechanical product.

The data associated with a Design\_characteristic are the following:

– defined\_for;  
– design\_stage.

#### 4.2.33.1 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which design characteristics are defined.

#### 4.2.33.2 design\_stage

The design\_stage attribute specifies the design stage in text format.

### 4.2.34 Design\_task

A Design\_task is a type of Task (see 4.2.189) and specifies the concept for collecting data which are attributable to a design task.

The data associated with a Design\_task are the following:

- type\_of\_task.

The type\_of\_task attribute specifies the type of design task in a text format.

### 4.2.35 Diesel\_engine

A Diesel\_engine is a type of Reciprocating\_machinery (see 4.2.161) which specifies the high level concept for all the marine diesel engines which need to be defined.

#### 4.2.36 Diesel\_engine\_design\_characteristic

A Diesel\_engine\_design\_characteristic is a type of Machinery\_design\_characteristic (see 4.2.90) which specifies the functional design characteristics of a diesel engine.

The data associated with a Diesel\_engine\_design\_characteristic are the following:

- piston\_speed.

The piston\_speed specifies the piston speed of the diesel engine.

#### 4.2.37 Diesel\_engine\_general\_characteristic

A Diesel\_engine\_general\_characteristic is a type of Reciprocating\_machinery\_general\_characteristic (see 4.2.163) which specifies the general characteristics (see 3.8.77) of a diesel engine.

The data associated with a Diesel\_engine\_general\_characteristic are the following:

- charge\_cooler\_arrangement;
- cylinder\_configuration;
- defined\_for;
- engine\_cycle;
- firing\_angle;
- firing\_interval;
- firing\_order;

- fuel\_injection\_system\_type;
- fuel\_oil\_system\_type;
- fuel\_type;
- piston\_guide\_type;
- pressure\_charging\_system;
- reversibility;
- starting\_system\_method;
- turbocharger\_type;
- vee\_angle.

#### 4.2.37.1 charge\_cooler\_arrangement

The charge\_cooler\_arrangement specifies the installed arrangement of the charge cooler.

#### 4.2.37.2 cylinder\_configuration

The cylinder\_configuration attribute specifies whether the engine cylinder configuration is of type in-line or Vee.

The value of cylinder\_configuration shall be one of the following:

- in-line;
- vee.

**4.2.37.2.1 in-line:** the descriptor which specifies that engine cylinders are in-line.

**4.2.37.2.2 vee:** the descriptor which specifies that engine cylinders are in Vee shape.

#### 4.2.37.3 defined\_for

The defined\_for attribute specifies a set of one to many diesel engines for which the general characteristics data are defined.

#### 4.2.37.4 engine\_cycle

The engine\_cycle attribute specifies whether the engine is a 4-stroke or a 2-stroke engine. The value of the engine\_cycle shall be one of the following:

- four\_stroke;
- two\_stroke.

**4.2.37.4.1 four\_stroke:** the descriptor which specifies that the engine is a four stroke type (two revolutions per engine cycle).

**4.2.37.4.2 two\_stroke:** the descriptor which specifies that the engine is a two stroke type (one revolution per engine cycle).

#### 4.2.37.5 firing\_angle

The `firing_angle` attribute specifies the angle in degrees at which cylinder ignition/injection takes place.

#### 4.2.37.6 `firing_interval`

The `firing_interval` attribute specifies the nominal interval (in degrees) between two consecutive ignitions.

#### 4.2.37.7 `firing_order`

The `firing_order` attribute specifies the order by which ignition takes place in different cylinders, within a single engine cycle. This is an ordered list of cylinder numbers.

#### 4.2.37.8 `fuel_injection_system_type`

The `fuel_injection_system_type` attribute specifies the type of fuel injection system.

The value of the `fuel_injection_system_type` shall be one of the following:

- `common_rail`;
- `distributor_type`;
- `user_defined_fuel_injection_system_type`.

**4.2.37.8.1 `common_rail`:** the descriptor which specifies that the type of fuel injection system is common rail.

**4.2.37.8.2 `distributor_type`:** the descriptor which specifies that the type of fuel injection system is of distributor type.

**4.2.37.8.3 `user_defined_fuel_injection_system_type`:** the descriptor, set by the user, which specifies the type of fuel injection system if different from the other options.

#### 4.2.37.9 `fuel_oil_system_type`

The `fuel_oil_system_type` attribute specifies the type of fuel oil system.

#### 4.2.37.10 `fuel_type`

The `fuel_type` attribute specifies the type of fuel for the diesel engine.

The value of the `fuel_type` shall be one of the following:

- `fuel_oil`;
- `gas_oil`;
- `user_defined_fuel_type`.

**4.2.37.10.1 `fuel_oil`:** the descriptor which specifies that the type of fuel is fuel oil.

**4.2.37.10.2 `gas_oil`:** the descriptor which specifies that the type of fuel is gas oil.



**4.2.37.10.3 user\_defined\_fuel\_type:** the descriptor, set by the user, which specifies the type of fuel if different from the other options.

#### **4.2.37.11 piston\_guide\_type**

The piston\_guide\_type attribute specifies the type of the piston guide in text format.

#### **4.2.37.12 pressure\_charging\_system**

The pressure\_charging\_system attribute specifies the type of diesel engine pressure charging system.

The value of pressure\_charging\_system shall be one of the following:

- naturally\_aspirated;
- supercharged;
- turbocharged;
- user\_defined\_pressure\_charging\_system.

**4.2.37.12.1 naturally\_aspirated:** the descriptor which specifies that the engine is a naturally aspirated one (not pressure charged).

**4.2.37.12.2 supercharged:** the descriptor which specifies that the engine is supercharged by air compressor using shaft power.

**4.2.37.12.3 turbocharged:** the descriptor which specifies that the engine is turbocharged.

**4.2.37.12.4 user\_defined\_pressure\_charging\_system:** the descriptor, set by the user, if the pressure charging system is different from the other options.

#### **4.2.37.13 reversibility**

The reversibility attribute specifies the engine capability to be driven in the reverse direction.

#### **4.2.37.14 starting\_system\_method**

The starting\_system\_method specifies the method of starting the diesel engine.

The value of the starting\_system\_method shall be one of the following:

- compressed\_air;
- electrical;
- hydraulic;
- user\_defined\_starting\_system\_method.

**4.2.37.14.1 compressed\_air:** the descriptor which specifies that the engine is started using a compressed air pneumatic system.

**4.2.37.14.2 electrical:** the descriptor which specifies that the engine is started using an electrical drive system.

**4.2.37.14.3 hydraulic:** the descriptor which specifies that the engine is started using a hydraulic drive system.

**4.2.37.14.4 user\_defined\_starting\_system\_method:** the descriptor, set by the user, which specifies the starting system method if different from the other options.

### **4.2.37.15 turbocharger\_type**

The turbocharger\_type attribute specifies the type of turbocharger used.

### **4.2.37.16 vee\_angle**

The vee\_angle attribute specifies the angle for the two banks of cylinders in a Vee-configured engine.

## **4.2.38 Diesel\_engine\_operational\_characteristic**

A Diesel\_engine\_operational\_characteristic is a type of Machinery\_operational\_characteristic (see 4.2.92) which specifies the operational data and operational characteristics of a diesel engine.

The data associated with a Diesel\_engine\_operational\_characteristic are the following:

- BMEP;
- brake\_power;
- brake\_torque;
- BSFC;
- cooling\_water\_data;
- defined\_for;
- exhaust\_emissions;
- IMEP;
- lube\_oil\_data;
- maximum\_cylinder\_pressure;
- shaft\_revolution\_counter.

### **4.2.38.1 BMEP**

The BMEP attribute specifies the brake mean effective pressure of a diesel engine.

### **4.2.38.2 brake\_power**

The brake\_power attribute specifies the brake power of a diesel engine.

#### **4.2.38.3 brake\_torque**

The brake\_torque attribute specifies the engine torque at crankshaft output.

#### **4.2.38.4 BSFC**

The BSFC attribute specifies the brake specific fuel consumption of a diesel engine.

#### **4.2.38.5 cooling\_water\_data**

The cooling\_water\_data attribute specifies the cooling water pressure, temperature and flowrate through reference to Fluid\_operational\_data (see 4.2.59) application object.

#### **4.2.38.6 defined\_for**

The defined\_for attribute specifies a set of one to many diesel engines for which operation data are defined.

#### **4.2.38.7 exhaust\_emissions**

The exhaust\_emissions attribute specifies the level of various exhaust emissions through reference to Exhaust\_emission (see 4.2.51) application object.

#### **4.2.38.8 IMEP**

The IMEP attribute specifies the indicated mean effective pressure of a diesel engine.

#### **4.2.38.9 lube\_oil\_data**

The lube\_oil\_data attribute specifies the cooling water pressure, temperature and flowrate through reference to Fluid\_operational\_data (see 4.2.59) application object.

#### **4.2.38.10 maximum\_cylinder\_pressure**

The maximum\_cylinder\_pressure attribute specifies the maximum firing pressure of the cylinder.

#### **4.2.38.11 shaft\_revolution\_counter**

The shaft\_revolution\_counter attribute specifies the value shown by the shaft revolution counter.

### **4.2.39 Dilatation**

A Dilatation is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the dilatation of something.

The data associated with a Dilatation are the following:

- dilatation\_unit.

The `dilatation_unit` attribute specifies all the units that can be used to specify dilatation.

#### **4.2.40 Direction**

A `Direction` specifies a general direction vector in two or three dimensional space. It is used as defined in ISO 10303-42.

#### **4.2.41 Document**

A `Document` specifies global identification information for a document.

The data associated with a `Document` are the following:

- `author`;
- `version_id`.

##### **4.2.41.1 author**

The `author` attribute specifies full details of the author of the document.

##### **4.2.41.2 version\_id**

The `version_id` attribute specifies the version number for identification of the document.

#### **4.2.42 Document\_reference**

A `Document_reference` is a type of `External_reference` (see 4.2.54) and a type of `Document` (see 4.2.41) and specifies the qualification of a `Document` in terms of its source and location.

#### **4.2.43 Drawing\_configuration**

A `Drawing_configuration` specifies information for identification of CAD drawings and their approval details.

The data associated with a `Drawing_configuration` are the following:

- `CAD_system_used`;
- `drawing_approval_details`;
- `drawing_description`;
- `drawing_id`;
- `drawing_title`;
- `drawing_type`.

##### **4.2.43.1 CAD\_system\_used**

The `CAD_system_used` attribute specifies the name and version number of the CAD system used to generate the drawing.

### 4.2.43.2 **drawing\_approval\_details**

The `drawing_approval_details` attribute specifies the summary information on the approval of a CAD drawing. A `Drawing_configuration` may have many `drawing_approval_details`.

### 4.2.43.3 **drawing\_description**

The `drawing_description` attribute specifies a textual description of the drawing, its context and modifications.

### 4.2.43.4 **drawing\_id**

The `drawing_id` attribute specifies the drawing identification number. A `Drawing_configuration` must have only one `drawing_id`.

### 4.2.43.5 **drawing\_title**

The `drawing_title` attribute specifies the full title of the drawing in a textual format.

### 4.2.43.6 **drawing\_type**

The `drawing_type` attribute specifies the type of the drawing.

The value of `drawing_type` shall be one of the following:

- `detailed_arrangement`;
- `general_arrangement`;
- `schematic`;
- `sectional_view`;
- `user_defined_drawing_type`.

**4.2.43.6.1 `detailed_arrangement`:** the descriptor which specifies that the drawing is a detailed arrangement.

**4.2.43.6.2 `general_arrangement`:** the descriptor which specifies that the drawing is of type general arrangement.

**4.2.43.6.3 `schematic`:** the descriptor which specifies that the drawing is of type schematic.

**4.2.43.6.4 `sectional_view`:** the descriptor which specifies that the drawing is of type sectional view.

**4.2.43.6.5 `user_defined_drawing_type`:** the descriptor, set by the user, which specifies the type of drawing if different from the other options.

## 4.2.44 **Electrical\_connection**

An `Electrical_connection` is a type of `Mechanical_product_connection` (see 4.2.113) which specifies the connection between a mechanical component and an electrical component or between two electrical components.

The data associated with an `Electrical_connection` are the following:

- `connection_type`.

The `connection_type` attribute specifies the type of electrical connection.

The value of the `connection_type` shall be one of the following:

- welded;
- socketed;
- `user_defined_connection_type`;
- welded.

**4.2.44.1 socketed:** The descriptor which specifies that the electrical connection is of type socketed.

**4.2.44.2 user\_defined\_connection\_type:** The descriptor, set by the user, which specifies the type of electric connection if different from the other options.

**4.2.44.3 welded:** The descriptor which specifies that the electrical connection is of type welded.

## 4.2.45 Electrical\_equipment

An `Electrical_equipment` is a type of `MP_equipment` (see 4.2.122) which specifies the high level concept for all the ship's electrical equipment which needs to be defined.

The data associated with an `Electrical_equipment` are the following:

- `type_of_electrical_equipment`.

The `type_of_electrical_equipment` attribute specifies the type of electrical machinery.

The value of the `type_of_electrical_equipment` shall be one of the following:

- `motor_starter`;
- `switch_board`;
- `transformer`;
- `user_defined_electric_equipment`;

**4.2.45.1 motor\_starter:** the descriptor which specifies that the electrical equipment is a motor starter.

**4.2.45.2 switch\_board:** the descriptor which specifies that the electrical equipment is a switch board.

**4.2.45.3 transformer:** the descriptor which specifies that the electrical equipment is a transformer.

**4.2.45.4 user\_defined\_electric\_equipment;** the descriptor, set by the user, which specifies the type of electrical equipment if different from the other options.

## **4.2.46 Electrical\_system**

An `Electrical_system` is a type of `Mechanical_system` (see 4.2.119) which specifies the high level concept for all the ship's electrical systems which need to be defined.

The data associated with an `Electrical_system` are the following:

- `type_of`

The `type_of` attribute specifies the type of electrical system.

## **4.2.47 Element\_content**

An `Element_content` specifies the significant compositional information about the solid material.

The data associated with an `Element_content` are the following:

- `element_content_percent`;
- `element_name`.

### **4.2.47.1 element\_content\_percent**

The `element_content_percent` attribute specifies the percentage of each compositional element.

### **4.2.47.2 element\_name**

The `element_name` attribute specifies the name of each compositional element.

## **4.2.48 Energy\_per\_mass**

An `Energy_per_mass` is a type of `Measure_with_unit` (see 4.2.104) when the physical quantity is the specific energy (energy per mass) of a material.

The data associated with an `Energy_per_mass` are the following:

- `energy_per_mass_unit`.

The `energy_per_mass_unit` attribute specifies all the units which can be used to specify density.

## 4.2.49 Engineering\_analysis\_definition

An Engineering\_analysis\_definition is a type of Definition (see 4.2.30) which specifies the high level concept for all the definitions (see 3.8.43) which are attributable to engineering analysis (see 3.8.56).

The data associated with an Engineering\_analysis\_definition are the following:

- engineering\_analysis\_in\_context;
- organisation.

### 4.2.49.1 engineering\_analysis\_in\_context

The engineering\_analysis\_in\_context attribute specifies the type of engineering analysis (see 3.8.56).

The value of engineering\_analysis\_in\_context shall be one of the following:

- CFD\_analysis;
- failure\_investigation;
- FEA;
- RAM\_analysis;
- thermodynamic\_analysis;
- vibration\_analysis;
- user\_defined\_analysis;

**4.2.49.1.1 CFD\_analysis:** the descriptor which specifies that the analysis is primarily of type CFD/analysis

**4.2.49.1.2 failure\_investigation:** the descriptor which specifies that the analysis is primarily of type failure investigation.

**4.2.49.1.3 FEA:** the descriptor which specifies that the analysis is primarily of type FEA.

**4.2.49.1.4 RAM\_analysis:** the descriptor which specifies that the analysis is primarily of type RAM analysis.

**4.2.49.1.5 thermodynamic\_analysis:** the descriptor which specifies that the analysis is primarily of type thermodynamic analysis.

**4.2.49.1.6 vibration\_analysis:** the descriptor which specifies that the analysis is primarily of type vibration analysis.

**4.2.49.1.7 user\_defined\_analysis:** the descriptor, set by the user, that specifies the type of engineering analysis if different from the other options.

### 4.2.49.2 organisation

The organisation attribute specifies the organisation which has carried out the engineering analysis.

## 4.2.50 Event



An Event identifies that something has happened at a certain time, activated by a certain person for a certain reason.

The data associated with an Event are the following:

- caused\_by;
- caused\_when;
- description.

#### **4.2.50.1 caused\_by**

The caused\_by attribute specifies the person causing an Event.

#### **4.2.50.2 caused\_when**

The caused\_when attribute specifies the date and time the Event occurred.

#### **4.2.50.3 description**

The description attribute specifies a textual description of significant features and reasons for the Event. The description need not be specified for a particular Event.

### **4.2.51 Exhaust\_emission**

An Exhaust\_emission specifies the concept for collecting the diesel engine exhaust emissions data.

The data associated with an Exhaust\_emission are the following:

- emissions\_units;
- nitrogen\_oxides;
- particulates;
- smoke;
- sulphur\_oxides;
- unburnt\_hydrocarbon.

#### **4.2.51.1 emissions\_units**

The emissions\_units attribute specifies the engineering units of exhaust emissions.

#### **4.2.51.2 nitrogen\_oxides**

The nitrogen\_oxides attribute specifies the level of exhaust nitrogen oxides.

#### **4.2.51.3 particulates**

The particulates attribute specifies the level of exhaust particulates.

#### 4.2.51.4 smoke

The smoke attribute specifies the level of exhaust smoke.

#### 4.2.51.5 sulphur\_oxides

The sulphur\_oxides attribute specifies the level of exhaust sulphur oxides.

#### 4.2.51.6 unburnt\_hydrocarbon

The unburnt hydrocarbon attribute specifies the level of exhaust unburnt hydrocarbon.

### 4.2.52 External\_instance\_reference

An External\_instance\_reference is a type of External\_reference (see 4.2.54) and specifies the concept for referencing an external instance of application objects in an exchange file.

The data associated with an External\_instance\_reference are the following:

- entity\_name;
- schema\_name.

#### 4.2.52.1 entity\_name

The entity\_name attribute specifies the name of the entity as a label.

#### 4.2.52.2 schema\_name

The schema\_name attribute specifies the name of the schema within which the entity is located, as a label.

### 4.2.53 External\_mechanical\_product\_definition

An External\_mechanical\_product\_definition is a type of External\_instance\_reference (see 4.2.52) and specifies the concept for referencing an externally defined instance of all the entities defined in this part of ISO 10303.

### 4.2.54 External\_reference

An External\_reference specifies the high level concept for referencing an information source, external to this part of ISO 10303.

The data associated with an External\_reference are the following:

- description;
- location;
- source\_type.

#### **4.2.54.1 description**

The description attribute specifies a description of the external source in text format.

#### **4.2.54.2 location**

The location attribute specifies the location of an external source in the form of an address.

#### **4.2.54.3 source\_type**

The source\_type attribute specifies the type of the external source.

### **4.2.55 External\_reference\_inside\_source**

An External\_reference\_inside\_source is a type of External\_reference (see 4.2.54) with a pointer to a location inside the source. If the source is for example a book, the pointer could be a section label or a page number.

The data associated with an External\_reference\_inside\_source are the following:

- line\_number;
- page;
- paragraph;
- section.

#### **4.2.55.1 line\_number**

The line\_number attribute specifies a line number. The line\_number need not be specified for a particular External\_reference\_inside\_source.

#### **4.2.55.2 page**

The page attribute specifies the page number. The page need not be specified for a particular External\_reference\_inside\_source.

#### **4.2.55.3 paragraph**

The attribute paragraph specifies the paragraph identifier. The paragraph need not be specified for a particular External\_reference\_inside\_source.

#### **4.2.55.4 section**

The section attribute specifies a section label. The section need not be specified for a particular External\_reference\_inside\_source.

### **4.2.56 Failure**

A Failure is a type of Product\_anomaly (see 4.2.146) which specifies the data which are attributable to a mechanical product failure.

The data associated with a Failure are the following:

- detailed\_failure\_cause;
- failure\_cause;
- failure\_criticality;
- failure\_descriptor;
- failure\_discovery\_description;
- failure\_effects;
- failure\_mode;
- failure\_related\_faults;
- failure\_related\_maintenances;
- failure\_type.

#### **4.2.56.1 detailed\_failure\_cause**

The detailed\_failure\_cause attribute specifies details of the cause of failure by referencing a document.

#### **4.2.56.2 failure\_cause**

The failure\_cause attribute specifies the cause of failure.

The value of the failure\_cause shall be one of the following:

- assembly\_error;
- improper\_design;
- improper\_manufacturing;
- improper\_material;
- installation\_error;
- maintenance\_error;
- management\_error;
- manufacturing\_error;
- off\_design\_service;
- operation\_error;
- user\_defined\_cause.

**4.2.56.2.1 assembly\_error:** the failure cause descriptor when failure is caused due to assembly deficiencies.

**4.2.56.2.2 improper\_design:** the failure cause descriptor when failure is caused due to design deficiencies.

**4.2.56.2.3 improper\_manufacturing:** the failure cause descriptor when failure is caused due to manufacturing deficiencies.

**4.2.56.2.4 improper\_material:** the failure cause descriptor when failure is caused due to deficiency in material properties.

**4.2.56.2.5 installation\_error:** the failure cause descriptor when failure is caused due to installation deficiencies.

**4.2.56.2.6 maintenance\_error:** the failure cause descriptor when failure is caused due to poor or wrong maintenance work.

**4.2.56.2.7 management\_error:** the failure cause descriptor when failure is caused due to managerial or administrative errors.

**4.2.56.2.8 manufacturing\_error:** the failure cause descriptor when failure is caused due to manufacturing deficiencies.

**4.2.56.2.9 off\_design\_error:** the failure cause descriptor when failure is caused due to operation under off-design conditions.

**4.2.56.2.10 operation\_error:** the failure cause descriptor when failure is caused due to errors during normal operation.

**4.2.56.2.11 user\_defined\_cause:** the failure cause descriptor, set by the user, when failure is caused by anything other than the other options.

### **4.2.56.3 failure\_criticality**

The failure\_criticality attribute specifies the criticality level of a failure.

The value of the failure\_criticality shall be one of the following:

- critical\_failure;
- non\_critical\_failure.

**4.2.56.3.1 critical\_failure:** the failure criticality descriptor when failure is classified as critical failure.

**4.2.56.3.2 non\_critical\_failure:** the failure criticality descriptor when failure is classified as non-critical failure.

#### **4.2.56.4 failure\_descriptor**

The failure\_descriptor attribute specifies the apparent, observed cause of a failure.

The value of the failure\_descriptor shall be one of the following:

- burning;
- burst;
- cavitation;
- clearance\_alignment;
- contamination;
- corrosion;
- deformation;
- fatigue;
- leakage;
- looseness;
- short\_circuit;
- sticking;
- user\_defined\_failure\_descriptor;
- vibration;
- wear.

**4.2.56.4.1 burning:** the descriptor which specifies that the failure is caused by a local burning.

**4.2.56.4.2 burst:** the descriptor which specifies that the failure is caused by bursting.

**4.2.56.4.3 cavitation:** the descriptor which specifies that the failure is caused by flow cavitation.

**4.2.56.4.4 clearance\_alignment:** the descriptor which specifies that the failure is caused by incorrect clearance alignment.

**4.2.56.4.5 contamination:** the descriptor which specifies that the failure is due to contamination.

**4.2.56.4.6 corrosion:** the descriptor which specifies that the failure is caused by corrosion.

**4.2.56.4.7 deformation:** the descriptor which specifies that the failure is caused by deformation of geometric shape.

**4.2.56.4.8 fatigue:** the descriptor which specifies that the failure is caused by fatigue.

**4.2.56.4.9 leakage:** the descriptor which specifies that the failure is caused by fluid leakage.

**4.2.56.4.10 looseness:** the descriptor which specifies that the failure is caused by looseness of components.

**4.2.56.4.11 short\_circuit:** the descriptor which specifies that the failure is caused by electrical short circuiting.

**4.2.56.4.12 sticking together:** the descriptor which specifies that the failure is caused by the moving components being stick together.

**4.2.56.4.13 user\_defined\_failure\_descriptor:** the descriptor, set by the user, which specifies an overall description of the cause of failure if different from the other options.

**4.2.56.4.14 vibration:** the descriptor which specifies that the failure is caused by excessive vibration.

**4.2.56.4.15 wear:** the descriptor which specifies that the failure is caused by wear and tear.

## **4.2.56.5 failure\_discovery\_description**

The failure\_discovery\_description attribute specifies the manner by which the failure is discovered in text format.

## **4.2.56.6 failure\_effects**

The failure\_effects attribute specifies various effects of a failure by referencing the Failure\_effect (see 4.2.57) application object.

## **4.2.56.7 failure\_mode**

The failure\_mode attribute specifies the manner by which a failure was discovered.

The value of the failure\_mode shall be one of the following:

- erratic\_behaviour;
- excessive\_noise;
- failed\_to\_start;
- failed\_to\_stop;
- high\_output;
- leakage;
- low\_output;
- overheating;
- unexpected\_stop;
- user\_defined\_mode.

**4.2.56.7.1 erratic\_behaviour:** the failure mode descriptor when failure is discovered in the form of equipment behaving in a erratic manner.

**4.2.56.7.2 excessive\_noise:** the failure mode descriptor when failure is discovered in the form of equipment generating significantly higher than expected noise.

**4.2.56.7.3 failed\_to\_start:** the failure mode descriptor when failure is discovered in the form of equipment failing to start on demand.

**4.2.56.7.4 failed\_to\_stop:** the failure mode descriptor when failure is discovered in the form of equipment failing to stop on demand.

**4.2.56.7.5 high\_output:** the failure mode descriptor when failure is discovered in the form of higher than expected output.

**4.2.56.7.6 leakage:** the failure mode descriptor when failure is discovered in the form of unexpected leakage.

**4.2.56.7.7 low\_output:** the failure mode descriptor when failure is discovered in the form of lower than expected output.

**4.2.56.7.8 overheating:** the failure mode descriptor when failure is discovered in the form of overheating.

**4.2.56.7.9 unexpected\_stop:** the failure mode descriptor when failure is discovered in the form of equipment stopping unexpectedly.

**4.2.56.7.10 user\_defined\_mode:** the failure mode descriptor, set by the user, when failure discovered in any other form than the stated options.

## **4.2.56.8 failure\_related\_faults**

The failure\_related\_faults attribute specifies the faults which are associated with a failure.

## **4.2.56.9 failure\_related\_maintenances**

The failure\_related\_maintenance attribute specifies the maintenance tasks which are associated with a failure.

## **4.2.56.10 failure\_type**

The failure\_type attribute specifies the classification of failure by discipline.

The value of the failure\_type shall be one of the following:

- electrical\_failure;
- mechanical\_failure;
- structural\_failure;
- user\_defined\_failure\_type.



**4.2.56.10.1 electrical\_failure:** the failure type descriptor when failure relates to the electrical aspects of the product.

**4.2.56.10.2 mechanical\_failure:** the failure type descriptor when failure relates to the mechanical aspects of the product.

**4.2.56.10.3 structural\_failure:** the failure type descriptor when failure relates to the structural aspects of the mechanical product.

**4.2.56.10.4 user\_defined\_failure\_type:** the failure type descriptor, set by the user, when failure relates to an engineering discipline other than the other options.

## **4.2.57 Failure\_effect**

A Failure\_effect specifies the data which define various effects of a failure.

The data associated with a Failure\_effect are the following:

- failure\_effect\_description;
- failure\_effect\_on\_ship.

### **4.2.57.1 failure\_effect\_description**

The failure\_effect\_description attribute specifies a textual description of the effect of failure.

### **4.2.57.2 failure\_effect\_on\_ship**

The failure\_effect\_on\_ship attribute specifies the effect of failure on a ship.

The value of the failure\_effect\_on\_ship shall be one of the following:

- complete\_failure\_of\_capability;
- degraded\_ship\_capability;
- normal\_ship\_operation;
- user\_defined\_effect\_on\_ship.

**4.2.57.2.1 complete\_failure\_of\_capability:** the descriptor that specifies that the failure has caused a complete loss of ship capability.

**4.2.57.2.2 degraded\_ship\_capability:** the descriptor that specifies that the failure has some degrading effect on ship capability such as performance, speed and mission.

**4.2.57.2.3 normal\_ship\_operation:** the descriptor that specifies that the failure has no significant effect on normal ship operation.

**4.2.57.2.4 user\_defined\_effect\_on\_ship:** the descriptor, set by the user, that specifies the effect of failure on ship if different from other options.

## 4.2.58 Fault

A Fault is a type of Product\_anomaly (see 4.2.146) which specifies the data which are attributable to a mechanical product fault.

The data associated with a Fault are the following:

- fault\_cause;
- fault\_class;
- fault\_method\_of\_diagnosis;
- fault\_related\_failures;
- fault\_related\_maintenances;
- fault\_severity\_functional;
- fault\_severity\_safety.

### 4.2.58.1 fault\_cause

The fault\_cause attribute specifies a textual description of the causes of the fault.

### 4.2.58.2 fault\_class

The fault\_class attribute specifies the type of fault.

The value of fault\_class shall be one of the following:

- design\_fault;
- mishandling\_fault;
- misuse\_fault;
- user\_defined\_fault\_class;
- wear\_out\_fault.

**4.2.58.2.1 design\_fault:** the descriptor which specifies that the fault has occurred because of improper design.

**4.2.58.2.2 mishandling\_faults:** the descriptor which specifies that the fault has occurred due to mishandling of the product.

**4.2.58.2.3 misuse\_fault:** the descriptor which specifies that the fault has occurred due to use of the mechanical product beyond its design and operational limits.

**4.2.58.2.4 user\_defined\_fault:** the descriptor, set by the user, which specifies the type of fault if different for the other options.

**4.2.58.2.5 wear\_out\_fault:** the descriptor which specifies that the fault has occurred due to wear and tear.

### 4.2.58.3 fault\_method\_of\_diagnosis

The `fault_method_of_diagnosis` attribute specifies the method by which the fault has been diagnosed.

The value of `fault_method_of_diagnosis` shall be one of the following:

- `class_survey`;
- `condition_monitoring_continuous`;
- `condition_monitoring_periodic`;
- `corrective_maintenance`;
- `functional_testing`;
- `inspection`;
- `user-defined_method_of_diagnosis`.

**4.2.58.3.1 `class_survey`:** the descriptor which specifies that the fault has been diagnosed as a result of a classification society survey.

**4.2.58.3.2 `condition_monitoring_continuous`:** the descriptor which specifies that the fault has been diagnosed using a continuous condition monitoring system.

**4.2.58.3.3 `condition_monitoring_periodic`:** the descriptor which specifies that the fault has been diagnosed as a result of a periodic condition monitoring.

**4.2.58.3.4 `corrective_maintenance`:** the descriptor which specifies that the fault has been diagnosed while performing a corrective maintenance task.

**4.2.58.3.5 `functional_testing`:** the descriptor which specifies that the fault has been diagnosed by functional testing of the equipment.

**4.2.58.3.6 `inspection`:** the descriptor which specifies that the fault has been diagnosed as a result of an inspection.

**4.2.58.3.7 `user_defined_method_of_diagnosis`:** the descriptor, set by the user, if the fault has been diagnosed by any other option.

## **4.2.58.4 `fault_related_failures`**

The `fault_related_failures` attribute specifies the failures which are associated to a fault.

## **4.2.58.5 `fault_related_maintenances`**

The `fault_related_maintenances` attribute specifies the maintenance tasks which are associated to a fault.

## **4.2.58.6 `fault_severity_functional`**

The `fault_severity_functional` attribute specifies a descriptor for the severity of the fault in relation to influencing the product's function.

The value of `fault_severity_functional` shall be one of the following:

- `complete_fault`;

- major\_fault;
- minor\_fault.

**4.2.58.6.1 complete\_fault:** the descriptor which specifies that the fault is a complete fault, resulting in a complete loss of the product's function.

**4.2.58.6.2 major\_fault:** the descriptor which specifies that the fault is a major fault, resulting in a significant loss of the product's function.

**4.2.58.6.3 minor\_fault:** the descriptor which specifies that the fault is a minor fault, resulting in no significant loss of product's function.

#### **4.2.58.7 fault\_severity\_safety**

The fault\_severity\_safety attribute specifies a descriptor for the severity of the fault in relation to safety of life or major assets.

The value of fault\_severity\_safety shall be one of the following:

- critical\_fault;
- non\_critical\_fault.

**4.2.58.7.1 critical\_fault:** the descriptor which specifies that the fault is a critical fault.

**4.2.58.7.2 non\_critical\_fault:** the descriptor which specifies that the fault is a non-critical fault.

#### **4.2.59 Fluid\_operational\_data**

A Fluid\_operational\_data specifies the fluid temperature, pressure and flowrate for any type of cooling/heating fluids.

The data associated with a Fluid\_operational\_data are the following:

- flowrate;
- fluid\_pressure;
- fluid\_temperature.

##### **4.2.59.1 flowrate**

The flowrate attribute specifies the flowrate of the fluid.

##### **4.2.59.2 fluid\_pressure**

The fluid-pressure attribute specifies the fluid pressure of the fluid.

##### **4.2.59.3 fluid\_temperature**

The fluid\_temperature attribute specifies the fluid temperature of the fluid.

## 4.2.60 Functional\_characteristic

A Functional\_characteristic is a type of Functional\_definition (see 4.2.61) and specifies the high level concept for all the definitions (see 3.8.43) which are attributable to the functional characteristics (see 3.8.72) of a mechanical product.

The data associated with a Functional\_characteristic are the following:

- function\_in\_context

The function\_in\_context attribute specifies and describes the context within which the functional characteristics is needed or going to be used. The function\_in\_context is an optional attribute.

## 4.2.61 Functional\_definition

A Functional\_definition is a type of Definition (see 4.2.30) and specifies the high level concept for all the functional (see 3.8.71) definitions which are attributable to mechanical products.

The data associated with a Functional\_definition are the following:

- the\_function;
- user\_def\_function.

### 4.2.61.1 the\_function

The the\_function attribute specifies the functionality of mechanical product.

### 4.2.61.2 user\_def\_function

The user\_def\_function specifies the functionality of mechanical product as assigned by the user.

## 4.2.62 Gas

A Gas specifies the high level concept for all the gaseous materials which need to be defined.

The data associated with a Gas are the following:

- gas\_type;

The gas\_type attribute specifies the type of gaseous material.

The value of the gas\_type shall be one of the following:

- air;
- exhaust\_gas;
- steam;
- user\_defined\_gas.

**4.2.62.1 air:** the descriptor which specifies that the gas is air.

**4.2.62.2 exhaust\_gas:** the descriptor which specifies that the gas is exhaust gas.

**4.2.62.3 steam:** the descriptor which specifies that the gas is steam.

**4.2.62.4 user\_defined\_gas:** the descriptor, set by the user, which specifies the type of gas if different from the other options.

### **4.2.63 Gas\_chemical\_property**

A Gas\_chemical\_property is a type of Gas\_material\_property (see 4.2.64) which specifies the chemical properties of a gas.

The data associated with a Gas\_chemical\_property are the following:

- composition\_by\_element;
- higher\_heating\_value;
- ignition\_temperature;
- lower\_heating\_value;
- mean\_molecular\_weight;
- other\_composition.

#### **4.2.63.1 composition\_by\_element**

The composition\_by\_element attribute specifies the composition of the gas in terms of its chemical elements.

#### **4.2.63.2 higher\_heating\_value**

The higher\_heating\_value attribute specifies the higher heating value of the gas.

#### **4.2.63.3 ignition\_temperature**

The ignition\_temperature attribute specifies the self-ignition temperature of the gas.

#### **4.2.63.4 lower\_heating\_value**

The lower\_heating\_value attribute specifies the lower heating value of the gas.

#### **4.2.63.5 mean\_molecular\_weight**

The mean\_molecular\_weight attribute specifies the mean molecular weight of the gas.

#### **4.2.63.6 other\_composition**

The `other_composition` attribute specifies the gas composition in terms of its constituents in a text format.

#### **4.2.64 Gas\_material\_property**

A `Gas_material_property` is a type of `Material_property` (see 4.2.103) which specifies the high level concept for all the properties which are attributable to a gas.

The data associated with a `Gas_material_property` are the following:

- `defined_for`.

The `defined_for` attribute specifies the type of gas for which gas properties have been defined.

#### **4.2.65 Gas\_physical\_property**

A `Gas_physical_property` is a type of `Gas_material_property` (see 4.2.64) which specifies the physical properties of a gas.

The data associated with a `Gas_physical_property` are the following:

- `density`;
- `reference_pressure`;
- `reference_temperature`;
- `thermal_conductivity`;
- `viscosity`.

##### **4.2.65.1 density**

The `density` attribute specifies the gas density.

##### **4.2.65.2 reference\_pressure**

The `reference_pressure` attribute specifies the reference pressure for all the pressure-dependent properties.

##### **4.2.65.3 reference\_temperature**

The `reference_temperature` attribute specifies the reference temperature for all the temperature-dependent properties.

##### **4.2.65.4 thermal\_conductivity**

The `thermal_conductivity` attribute specifies the gas thermal conductivity.

##### **4.2.65.5 viscosity**

The `viscosity` attribute specifies the gas viscosity.

#### 4.2.66 Gear\_box

A Gear\_box is a type of Mechanical\_equipment (see 4.2.107.) and specifies the data representation concept for all the gear boxes which need to be defined.

The data associated with a Gear\_box are the following:

- gear\_box\_type.

The gear\_box\_type attribute specifies the type of gear box in a text format.

#### 4.2.67 Geometric\_definition

A Geometric\_definition is a type of Physical\_definition (see 4.2.135) and specifies the high level concept for all the definitions attributable to shape and various dimensional characteristics of a mechanical product.

The data associated with a Geometric\_definition are the following:

- usage\_in\_context.

The usage\_in\_context attribute specifies for what purpose the geometric definitions are going to be used. The usage\_in\_context is an optional attribute in text format.

#### 4.2.68 Geometric\_representation\_item

A Geometric\_representation\_item is an element of geometric product data that either participates in one or more representations. It is used as defined in ISO 10303-42.

#### 4.2.69 GUID

A GUID is a global unique identifier used for uniquely identifying an externally referenced entity.

The data associated with a GUID are the following:

- company\_identification;
- company\_name.

##### 4.2.69.1 company\_identification

The company\_identification attribute is a company-specific unique identification label.

##### 4.2.69.2 company\_name

The company\_name attribute is the name of the company for which company\_identification (see 4.2.69.1) is specified.

#### 4.2.70 Heat\_capacity



A Heat\_capacity is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the heat capacity of a material.

The data associated with a Heat\_capacity are the following:

- heat\_capacity\_unit.

The heat\_capacity\_unit attribute specifies all the units which can be used for heat capacity.

## **4.2.71 Heat\_exchanger**

A Heat\_exchanger is a type of Process\_equipment (see 4.2.145) and specifies the data representation concept for all the heat exchangers which need to be defined.

The data associated with a Heat\_exchanger are the following:

- heat\_exchanger\_role;
- heat\_exchanger\_type.

### **4.2.71.1 heat\_exchanger\_role**

The heat\_exchanger\_role attribute specifies the role of the heat exchanger.

The value of heat\_exchanger\_role shall be one of the following:

- air\_cooler;
- air\_heater;
- economiser;
- fuel\_preheater;
- oil\_cooler;
- oil\_heater;
- recuperator;
- regenerator;
- water\_cooler;
- water\_heater;
- user\_defined\_heat\_exchanger\_role.

**4.2.71.1.1 air\_cooler:** the descriptor which specifies that the heat exchanger is used as an air cooler.

**4.2.71.1.2 air\_heater:** the descriptor which specifies that the heat exchanger is used as an air heater.

**4.2.71.1.3 economiser:** the descriptor which specifies that the heat exchanger is used as an economiser.

**4.2.71.1.4 fuel\_preheater:** the descriptor which specifies that the heat exchanger is used as a fuel preheater.

**4.2.71.1.5 oil\_cooler:** the descriptor that specifies which the heat exchanger is used as an oil cooler.

**4.2.71.1.6 oil\_heater:** the descriptor which specifies that the heat exchanger is used as an oil heater.

**4.2.71.1.7 recuperator:** the descriptor which specifies that the heat exchanger is used as a recuperator.

**4.2.71.1.8 regenerator:** the descriptor which specifies that the heat exchanger is used as a regenerator.

**4.2.71.1.9 water\_cooler:** the descriptor which specifies that the heat exchanger is used as a water cooler.

**4.2.71.1.10 water\_heater:** the descriptor which specifies that the heat exchanger is used as a water heater.

**4.2.71.1.11 user\_defined\_heat\_exchanger\_role:** the descriptor, set by the user, which specifies the role of the heat exchanger if different from the other options.

## **4.2.71.2 heat\_exchanger\_type**

The `heat_exchanger_type` attribute specifies the type of heat exchanger.

The value of `heat_exchanger_type` shall be one of the following:

- `shell_and_tube_counter_flow`;
- `shell_and_tube_cross_flow`;
- `shell_and_tube_parallel_flow`;
- `user_defined_heat_exchanger_type`.

**4.2.71.2.1 shell\_and\_tube\_counter\_flow:** the descriptor which specifies that the heat exchanger is of type shell and tube with counter flow.

**4.2.71.2.2 shell\_and\_tube\_cross\_flow:** the descriptor which specifies that the heat exchanger is of type shell and tube with cross flow.

**4.2.71.2.3 shell\_and\_tube\_parallel\_flow:** the descriptor which specifies that the heat exchanger is of type shell and tube with parallel flow.

**4.2.71.2.4 user\_defined\_heat\_exchanger\_type:** the descriptor, set by the user, which specifies the type of heat exchanger if different from the other options.

## **4.2.72 Human\_resource**

A Human\_resource is a type of Task\_resource (see 4.2.197) which specifies the data which relate to human resources required to perform a task.

The data associated with a Human\_resource are the following:

- man\_time;
- personnel.

### **4.2.72.1 man\_time**

The man\_time attribute specifies the time needed/used to perform a task.

### **4.2.72.2 personnel**

The personnel attribute specifies the particulars of the personnel needed for carrying out the task.

## **4.2.73 Inertia\_moment**

An Inertia\_moment is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the moment of inertia of something.

The data associated with an Inertia\_moment are the following:

- inertia\_moment\_unit.

The inertia\_moment\_unit attribute specifies all the units which can be used to specify moment of inertia.

## **4.2.74 Item**

An Item is a type of Definable\_object (see 4.2.29) and specifies the high level concept for any of the ship's items (see 3.8.82) which need to be defined or described.

The data associated with an Item are the following:

- description;
- documentation;
- id;
- ship\_context.

#### **4.2.74.1 description**

The description specifies a textual description for the item.

#### **4.2.74.2 documentation**

The documentation specifies the documentation available, if any, for the item. The documentation is an optional attribute. There may be more than one documentation for an Item.

#### **4.2.74.3 id**

The id specifies a text string for identification of the item.

#### **4.2.74.4 ship\_context**

The ship\_context specifies the context of the item in terms of its applicability or belonging to a ship. The ship\_context need not be specified for a particular item.

### **4.2.75 Item\_relationship**

An Item\_relationship is the supertype for all the Mechanical\_product\_relationship (see 4.2.116) and defines the association between two items.

The data associated with an Item\_relationship are the following:

- context;
- item\_1;
- item\_2.

#### **4.2.75.1 context**

The context attribute specifies the significant aspect of the relationship in the form of a label.

#### **4.2.75.2 item\_1**

The item\_1 attribute specifies the first item which takes part in the relationship.

#### **4.2.75.3 item\_2**

The item\_2 attribute specifies the second item which takes part in the relationship.

### 4.2.76 Item\_structure

An Item\_structure is a type of Definable\_object (see 4.2.29).

The data associated with an Item\_structure are the following:

- item\_relationships;
- items.

#### 4.2.76.1 item\_relationships

The item\_relationships attribute specifies the relationship between items which are part of an item\_structure.

#### 4.2.76.2 items

The items attribute specifies the particulars of products which belong to a product structure. There may be more than one item for an Item\_structure.

### 4.2.77 Label

A Label application object is used to assign a character label to something. It is used as defined in ISO 10303-41.

### 4.2.78 Length

A Length is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the length of something.

The data associated with a Length are the following:

- length\_unit.

The length\_unit attribute specifies all the units which can be used to specify length.

### 4.2.79 Lifting\_equipment

A Lifting\_equipment is a type of MP\_equipment (see 4.2.122) and specifies the high level concept for all the lifting equipments which need to be defined.

The data associated with a Lifting\_equipment are the following:

- lifting\_equipment\_type.

The lifting\_equipment\_type attribute specifies the type of lifting equipment.

The value of lifting\_equipment\_type shall be one of the following:

- crane;

- derrick;
- user\_defined\_lifting\_equipment\_type.

**4.2.79.1 crane:** the descriptor which specifies that the lifting equipment is a crane.

**4.2.79.2 derrick:** the descriptor which specifies that the lifting equipment is a derrick.

**4.2.79.3 user\_defined\_lifting\_equipment\_type:** the descriptor, set by the user, which specifies the type of lifting equipment if different from the other options.

## **4.2.80 Lifting\_equipment\_design\_characteristic**

A Lifting\_equipment\_design\_characteristic is a type of Design\_characteristic (see 4.2.33) and specifies the concept for collecting all the definitions which are attributable to the design characteristic of all types of lifting equipment.

The data associated with a Lifting\_equipment\_design\_characteristic are the following:

- defined\_for;
- lifting\_capacity;
- nature\_of\_lifting\_operation.

### **4.2.80.1 defined\_for**

The defined\_for attribute specifies a set of one to many lifting equipments for which the definitions are defined.

### **4.2.80.2 lifting\_capacity**

The lifting\_capacity attribute specifies the maximum load which can be lifted by the lifting equipment.

### **4.2.80.3 nature\_of\_lifting\_operation**

The nature\_of\_lifting\_operation attribute specifies the nature of the operation of the lifting equipment in text format.

## **4.2.81 Liquid**

A liquid specifies the high level concept for all the liquid materials which need to be defined.

The data associated with a Liquid are the following:

- liquid\_type;

The liquid\_type attribute specifies the type of liquid material.

The value of the liquid\_type shall be one of the following:

- fuel\_oil;

- gas\_oil;
- lubrication\_oil;
- user\_defined\_liquid;
- water.

**4.2.81.1 fuel\_oil:** the descriptor which specifies that the liquid is fuel oil.

**4.2.81.2 gas\_oil:** the descriptor which specifies that the liquid is gas oil.

**4.2.81.3 lubrication\_oil:** the descriptor which specifies that the liquid is lubrication oil.

**4.2.81.4 user\_defined\_liquid:** the descriptor, set by the user, if the type of liquid is different from the other options.

**4.2.81.5 water:** the descriptor which specifies that the liquid is water.

## **4.2.82 Liquid\_chemical\_property**

A Liquid\_chemical\_property is a type of Liquid\_material\_property (see 4.2.85) which specifies the chemical properties of a liquid.

The data associated with a Liquid\_chemical\_property are the following:

- ignition\_temperature.

The ignition\_temperature attribute specifies the ignition temperature of a liquid.

## **4.2.83 Liquid\_fluid\_impurity**

A Liquid\_fluid\_impurity specifies the level of impurities in a liquid.

The data associated with a Liquid\_fluid\_impurity are the following:

- liquid\_impurity\_contents;
- metallic\_impurity\_contents;
- total\_sediments\_percent.

### **4.2.83.1 liquid\_impurity\_contents**

The liquid\_impurity\_contents attribute specifies all the trace liquids together with their percentage level.

### **4.2.83.2 metallic\_impurity\_contents**

The metallic\_impurity\_contents attribute specifies all the trace metals together with their percentage level.

### **4.2.83.3 total\_sediments\_percent**

The `total_sediments_percent` attribute specifies the total percentage of sediments (see 3.8.137).

#### 4.2.84 Liquid\_impurity

A `Liquid_impurity` specifies the name and level of each liquid-type impurity.

The data associated with a `Liquid_impurity` are the following:

- `liquid_content_percent`;
- `liquidname`.

##### 4.2.84.1 liquid\_content\_percent

The `liquid_content_percent` attribute specifies the level of impurity in percentage.

##### 4.2.84.2 liquid\_name

The `liquid_name` attribute specifies the name of the liquid.

The value of `liquid_name` shall be one of the following:

- `oil`;
- `user_defined_liquid`;
- `water`.

**4.2.84.2.1 oil:** the descriptor which specifies that the impurity is oil.

**4.2.84.2.2 user\_defined\_liquid:** the descriptor, set by the user, which specifies the name of the liquid impurity if different from the other options.

**4.2.84.2.3 water:** the descriptor which specifies that the impurity is water.

#### 4.2.85 Liquid\_material\_property

A `Liquid_material_property` is a type of `Material_property` (see 4.2.103) and specifies the high level concept for all the properties which are attributable to liquids.

The data associated with a `Liquid_material_property` are the following:

- `defined_for`.

The `defined_for` attribute specifies the type of liquid for which the properties are being defined.

#### 4.2.86 Liquid\_physical\_property

A `Liquid_physical_property` is a type of `Liquid_material_property` (see 4.2.85) which specifies the physical properties of a liquid.

The data associated with a `Liquid_physical_property` are the following:



- density;
- flash\_point;
- heat\_capacity;
- impurities;
- pour\_point;
- reference\_pressure;
- reference\_temperature;
- surface\_tension;
- thermal\_conductivity;
- viscosity.

#### **4.2.86.1 density**

The density attribute specifies the liquid density at reference temperature.

#### **4.2.86.2 flash\_point**

The flash\_point attribute specifies the liquid flash point.

#### **4.2.86.3 heat\_capacity**

The heat\_capacity attribute specifies the liquid heat capacity at reference temperature.

#### **4.2.86.4 impurities**

The impurities attribute specifies the level of different impurities in the liquid.

#### **4.2.86.5 pour\_point**

The pour\_point attribute specifies the liquid pour point.

#### **4.2.86.6 reference\_pressure**

The reference\_pressure attribute specifies the reference pressure for all the pressure-dependent properties.

#### **4.2.86.7 reference\_temperature**

The reference\_temperature attribute specifies the reference temperature for all the temperature-dependent properties.

#### **4.2.86.8 surface\_tension**

The surface\_tension attribute specifies the liquid surface tension at reference temperature.

#### **4.2.86.9 thermal\_conductivity**

The thermal\_conductivity attribute specifies the liquid thermal conductivity at reference temperature.

## 4.2.86.10 viscosity

The viscosity attribute specifies the liquid viscosity at reference temperature.

## 4.2.87 Local\_co\_ordinate\_system

A Local\_co\_ordinate\_system is used to locate something in space. A Local\_co\_ordinate\_system is always defined with respect to another coordinate system, this might be the global coordinate system or another local coordinate system.

### NOTES

1 – The local axes directions are called U, V, W. The local W-direction is normal to the plane, defined by local\_u and local\_v

2 – A local coordinate system shall form a right handed system.

The data associated with a Local\_coordinate\_system are the following:

- local\_u;
- local\_v;
- local\_w;
- parent\_to\_coordinate\_system;
- u\_value;
- v\_value;
- w\_value.

### 4.2.87.1 local\_u

The local\_u attribute specifies the local axis, defined in the underlying coordinate system, global or local.

### 4.2.87.2 local\_v

The local\_v attribute specifies the local axis perpendicular to local\_u, defined in the underlying coordinate system, global or local.

### 4.2.87.3 local\_w

The local\_w attribute specifies the local axis perpendicular to local\_u and local\_v, defined in the underlying coordinate system, global or local.

### 4.2.87.4 parent\_to\_coordinate\_system

The parent\_to\_coordinate\_system attribute specifies the underlying coordinate system which serves as definition space for this coordinate system. The parent coordinate system will be specified in text format.

### 4.2.87.5 u\_value

The `u_value` attribute specifies the coordinate for the origin, value along parent u-axis.

#### 4.2.87.6 `v_value`

The `v_value` attribute specifies the coordinate for the origin, value along parent v-axis.

#### 4.2.87.7 `w_value`

The `w_value` attribute specifies the coordinate for the origin, value along parent w-axis.

### 4.2.88 Machinery

A Machinery is a type of MP\_equipment (see 4.2.122) and specifies the high level concept for all types of machinery (see 3.8.88) which need to be defined.

The data associated with a Machinery are the following:

- `machinery_type`.

The `machinery_type` attribute specifies the type of machinery.

The value of `machinery_type` shall be one of the following:

- `electrical_machinery`;
- `mechanical_machinery`;
- `process_machinery`;
- `user_defined_machinery`.

**4.2.88.1 `electrical_machinery`:** the descriptor which specifies that the machinery is of type electrical machinery (see 3.8.54).

**4.2.88.2 `mechanical_machinery`:** the descriptor which specifies that the machinery is of type mechanical machinery (see 3.8.101).

**4.2.88.3 `process_machinery`:** the descriptor which specifies that machinery is of type process machinery.

**4.2.88.4 `user-defined_machinery`:** the descriptor, set by the user, if type of machinery is different from the other options.

### 4.2.89 Machinery\_ambient\_condition

A Machinery\_ambient\_condition is a type of Ambient\_condition (see 4.2.2) and specifies the ambient conditions for a machinery.

The data associated with a Machinery\_ambient\_condition are the following:

- `ambient_pressure_maximum`;
- `ambient_pressure_minimum`;

- ambient\_temperature\_maximum;
- ambient\_temperature\_minimum;
- defined\_for.

#### **4.2.89.1    ambient\_pressure\_maximum**

The ambient\_pressure\_maximum attribute specifies the maximum ambient pressure for which the machinery has been designed.

#### **4.2.89.2    ambient\_pressure\_minimum**

The ambient\_pressure\_minimum attribute specifies the minimum ambient pressure for which the machinery has been designed.

#### **4.2.89.3    ambient\_temperature\_maximum**

The ambient\_temperature\_maximum attribute specifies the maximum temperature for which the machinery has been designed.

#### **4.2.89.4    ambient\_temperature\_minimum**

The ambient\_temperature\_minimum attribute specifies the minimum temperature for which the machinery has been designed.

#### **4.2.89.5    defined\_for**

The defined\_for attribute specifies a set of one to many machineries for which the definitions are defined.

### **4.2.90    Machinery\_design\_characteristic**

A Machinery\_design\_characteristic is a type of Design\_characteristic (see 4.2.33) and specifies the functional design data which are attributable to all types of machineries.

The data associated with a Machinery\_design\_characteristic are the following:

- defined\_for;
- design\_points;
- overload\_characteristics;
- rotational\_speed\_maximum;
- rotational\_speed\_minimum;
- power\_maximum.

#### **4.2.90.1    defined\_for**

The defined\_for attribute specifies a set of one to many machineries for which the definitions are defined.

#### **4.2.90.2 design\_points**

The design\_points attribute specifies a set of operating conditions, which are significant from a design point of view, by referencing an Operating\_point (see 4.2.126) application object.

#### **4.2.90.3 overload\_characteristics**

The overload\_characteristics attribute specifies the machinery overload specifications in a textual descriptor format.

#### **4.2.90.4 rotational\_speed\_maximum**

The rotational\_speed\_maximum attribute specifies the maximum/rated operational speed of the machinery.

#### **4.2.90.5 rotational\_speed\_minimum**

The rotational\_speed\_minimum attribute specifies the minimum/idle operational speed of the machinery.

#### **4.2.90.6 power\_maximum**

The power\_maximum attribute specifies the maximum/rated power of the machinery.

### **4.2.91 Machinery\_general\_characteristic**

A Machinery\_general\_characteristic is a type of MP\_equipment\_general\_characteristic (see 4.2.123) and specifies the high level concept for all the general characteristics data which need to be attributed to all types of machinery.

The data associated with a Machinery\_general\_characteristic are the following:

- defined\_for;
- direction\_of\_rotation;
- lube\_oil\_system\_type.

#### **4.2.91.1 defined\_for**

The defined\_for attribute specifies a set of one to many machineries for which the definitions are defined.

#### **4.2.91.2 direction\_of\_rotation**

The direction\_of\_rotation attribute specifies the machinery direction of rotation.

The value of direction\_of\_rotation shall be one of the following:

- anti\_clockwise;
- clockwise.

**4.2.91.2.1 anti\_clockwise:** The descriptor which specifies that the machinery rotates anti-clockwise when viewed from the left.

**4.2.91.2.2 clockwise:** The descriptor which specifies that the machinery rotates clockwise when viewed from the left.

### **4.2.91.3 lube\_oil\_system\_type**

The lube\_oil\_system\_type attribute specifies the type of machinery lubrication system in a text format.

## **4.2.92 Machinery\_operational\_characteristic**

A Machinery\_operational\_characteristic is a type of Operational\_characteristic (see 4.2.128) and specifies the operational data which are attributable to all kinds of machinery.

The data associated with a Machinery\_operational\_characteristic are the following:

- accumulated\_revolution\_counter;
- accumulated\_shaft\_energy;
- defined\_for;
- operating points.

### **4.2.92.1 accumulated\_revolution\_counter**

The accumulated\_revolution\_counter attribute specifies the total number of revolutions of the machinery so far in its lifecycle.

### **4.2.92.2 accumulated\_shaft\_energy**

The accumulated\_shaft\_energy attribute specifies the total energy provided or consumed by the machinery at its output/input shaft so far in its lifecycle.

### **4.2.92.3 defined\_for**

The defined\_for attribute specifies a set of one to many machineries for which the definitions are defined.

### **4.2.92.4 operating points**

The operating\_points attribute specifies a set of operating conditions by referencing an Operating\_point (see 4.2.126) application object.

## **4.2.93 Maintainability**

A Maintainability specifies the data which are attributable to the maintainability performance (see 3.7) of a mechanical product.

The data associated with a Maintainability are the following:

- maintainability;
- mean\_logistic\_delay;
- mean\_maintenance\_man\_hour;
- mean\_time\_to\_repair.

#### **4.2.93.1 maintainability**

The maintainability attribute specifies the probability that a given maintenance action can be completed within a stated time interval.

#### **4.2.93.2 mean\_logistic\_delay**

The mean\_logistic\_delay attribute specifies the level of delays due to logistical problems in relation to the maintenance of a product.

#### **4.2.93.3 mean\_maintenance\_man\_hour**

The mean\_maintenance\_man\_hour attribute specifies the level of expected man-hours for maintenance actions.

#### **4.2.93.4 mean\_time\_to\_repair**

The mean\_time\_to\_repair attribute specifies the maintainability performance of a product in terms of its expected/actual mean time to repair.

### **4.2.94 Maintenance\_configuration\_data**

A Maintenance\_configuration\_data is a type of Task\_configuration (see 4.2.191) that specifies the configuration (see 3.8.32) for a maintenance task.

The data associated with the Maintenance\_configuration\_data are the following:

- defined\_for;
- maintenance\_class\_by\_discipline;
- maintenance\_type;
- maintenance\_type\_iso.

#### **4.2.94.1 defined\_for**

The defined\_for attribute specifies a set of one to many maintenance tasks for which configuration data are defined.

#### **4.2.94.2 maintenance\_class\_by\_discipline**

The maintenance\_class\_by\_discipline attribute specifies the classification of maintenance by engineering discipline.

The value of `maintenance_class_by_discipline` shall be one of the following:

- electrical;
- electronic;
- mechanical;
- `user_defined_discipline`.

**4.2.94.2.1 electrical:** the descriptor which specifies that the maintenance relates to the electrical aspect of the product.

**4.2.94.2.2 electronic:** the descriptor which specifies that the maintenance relates to the electronic aspect of the product.

**4.2.94.2.3 mechanical:** the descriptor which specifies that the maintenance relates to the mechanical aspect of the product.

**4.2.94.2.4 user\_defined\_discipline:** the descriptor, to be set by the user, which specifies the maintenance related engineering discipline, if different from the other options.

### 4.2.94.3 `maintenance_type`

The `maintenance_type` attribute specifies the type of maintenance.

The value of `maintenance_type` shall be one of the following:

- corrective;
- `preventive_condition_based`;
- `preventive_time_based`.

**4.2.94.3.1 corrective:** the descriptor which specifies that the maintenance is of type corrective maintenance.

**4.2.94.3.2 preventive\_condition\_based:** the descriptor which specifies that the maintenance is of type preventive maintenance and is based on the condition of the product rather than a pre-defined time schedule.

**4.2.94.3.3 preventive\_time\_based:** the descriptor which specifies that the maintenance is of type preventive maintenance and is based on a pre-defined time schedule.

### 4.2.94.4 `maintenance_type_iso`

The `maintenance_type_iso` attribute specifies the type of maintenance according to IEC 50 standard.

The value of `maintenance_type_iso` shall be one of the following:

- corrective;
- preventive.



**4.2.94.4.1 corrective:** the descriptor which specifies that the maintenance is of type corrective maintenance.

**4.2.94.4.2 preventive:** the descriptor which specifies that the maintenance is of type preventive maintenance.

## **4.2.95 Maintenance\_human\_resource**

A Maintenance\_human\_resource is a type of Human\_resource (see 4.2.72) that specifies the human resources needed to perform the maintenance task.

The data associated with a Maintenance\_resource are the following:

- defined\_for.

The defined\_for attribute specifies a set of one to many maintenance tasks for which human resources need to be defined.

## **4.2.96 Maintenance\_procedure**

A Maintenance\_procedure is a type of Task\_procedure (see 4.2.195) that specifies the procedures for carrying out a maintenance task.

The data associated with a Maintenance\_procedure are the following:

- defined\_for.

The defined\_for attribute specifies a set of one to many maintenance tasks for which maintenance procedures need to be defined.

## **4.2.97 Maintenance\_result**

A Maintenance\_result is a type of Task\_result (see 4.2.198) that specifies the results of a maintenance task.

The data associated with a Maintenance\_result are the following:

- defined\_for.

The defined\_for attribute specifies a set of one to many maintenance tasks for which maintenance results need to be defined.

## **4.2.98 Maintenance\_schedule**

A Maintenance\_schedule is a type of Task\_schedule (see 4.2.199) which specifies the schedule needed for a maintenance task.

The data associated with a Maintenance\_schedule are the following:

- defined\_for.

The `defined_for` attribute specifies a set of one to many maintenance tasks for which the schedule needs to be defined.

#### **4.2.99 Maintenance\_spare\_part**

A `Maintenance_spare_part` is a type of `Spare_part` (see 4.2.181) which specifies the spare parts needed for a maintenance task.

The data associated with a `Maintenance_spare_part` are the following:

- `defined_for`.

The `defined_for` attribute specifies a set of one to many maintenance tasks for which the spare parts need to be defined.

#### **4.2.100 Maintenance\_task**

A `Maintenance_task` is a type of `Task` (see 4.2.189) which specifies the high level concept for all the maintenance tasks (see 3.8.155) which need to be defined.

The data associated with a `Maintenance_task` are the following:

- `maintenance_category`;
- `maintenance_related_failures`.

##### **4.2.100.1 maintenance\_category**

The `maintenance_category` attribute specifies the category of maintenance in terms of main maintenance activities.

The value of `maintenance_category` shall be one of the following:

- `adjust`;
- `refit`;
- `repair`;
- `replace`;
- `service`;
- `user_defined_category`.

**4.2.100.1.1 adjust:** the descriptor which specifies that the main activity of the maintenance task is the adjustment of a product or its components.

**4.2.100.1.2 refit:** the descriptor which specifies that the main activity of the maintenance task is the refit of a product or its components.

**4.2.100.1.3 repair:** the descriptor which specifies that the main activity of the maintenance task is the repair of a product or its components.

**4.2.100.1.4 replace:** the descriptor which specifies that the main activity of the maintenance task is the replacement of a product or its components.

**4.2.100.1.5 service:** the descriptor which specifies that the main activity of the maintenance task is to service a product or its components.

**4.2.100.1.6 user\_defined\_category:** the descriptor, set by the user, which specifies the maintenance category, if different from the other options.

## **4.2.100.2 maintenance\_related\_failures**

The maintenance\_related\_failures attribute specifies the failures which are related to the maintenance.

## **4.2.101 Mass**

A Mass is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is a mass as defined in ISO 31 (clause 2).

The data associated with a Mass are the following:

- mass\_unit.

The mass\_unit attribute specifies all the units which can be used for mass.

## **4.2.102 Mass\_weight\_inertia**

A Mass\_weight\_inertia is a type of Physical\_definition (see 4.2.135) and specifies the high level concept for all the definitions (see 3.8.43) which are attributable to mass, weight and inertia of the mechanical product.

The data associated with a Mass\_weight\_inertia are the following:

- centre\_of\_gravity;
- defined\_for;
- inertia;
- mass;
- weight.

#### **4.2.102.1 centre\_of\_gravity**

The centre\_of\_gravity attribute specifies the centre of gravity of the mechanical product as a point in a cartesian coordinate system.

#### **4.2.102.2 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which mass, weight, inertia and centre of gravity are defined.

#### **4.2.102.3 inertia**

The inertia attribute specifies the moment of inertia (see 3.8.79) of the mechanical product, if applicable.

#### **4.2.102.4 mass**

The mass attribute specifies the mass of the mechanical product.

#### **4.2.102.5 weight**

The weight attribute specifies the weight of the mechanical product and is derived from mass.

### **4.2.103 Material\_property**

A Material\_property specifies the high level concept and data for all types of material properties. The Material\_property is the supertype for Gas\_material\_property (see 4.2.64), Liquid\_material\_property (see 4.2.85) and Solid\_material\_property (see 4.2.179).

The data associated with a Material\_property are the following:

- description;
- version\_id.

#### **4.2.103.1 description**

The description attribute specifies a general description of the material and its properties in text format.

#### **4.2.103.2 version\_id**

The version\_id attribute specifies an identification label for a set of material properties.

### **4.2.104 Measure\_with\_unit**

A Measure\_with\_unit is the specification of a physical quantity as defined in ISO 31 (clause 2). Each Measure\_with\_unit may be one of the following: a Density (see 4.2.31), a Dilatation (see 4.2.39), a Heat\_capacity (see 4.2.70), an Inertia\_moment (see 4.2.73), a Length (see 4.2.78), a Mass (see 4.2.101), a Plane\_angle (see 4.2.141), a Power (see 4.2.142), a Pressure (see 4.2.144), a Ratio (see

4.2.160), a Stress (see 4.2.184), a Surface\_tension (see 4.2.187), a Temperature (see 4.2.200), a Thermal\_conductivity (see 4.2.202), a Time (see 4.2.203), and a Viscosity (see 4.2.212).

The data associated with a Measure\_with\_unit are the following:

- qualifier;
- value.

#### **4.2.104.1 qualifier**

The qualifier attribute specifies additional information in text format which describes the scope of the value. Aspects such as normalisation, correction, averaging, measured/predicted/estimated can be specified using the qualifier attribute.

#### **4.2.104.2 value**

The value attribute specifies the value of the physical quantity when expressed in the specified units.

### **4.2.105 Mechanical\_component**

A Mechanical\_component is a type of Mechanical\_product\_component (see 4.2.112) and specifies the high level concept for all the mechanical components (see 3.8.98) which need to be defined.

The data associated with a Mechanical\_component are the following:

- mechanical\_component\_type.

The mechanical\_component\_type attribute specifies the type of the mechanical component.

The value of mechanical\_component\_type shall be one of the following:

- cylinder;
- cylinder\_liner;
- exhaust\_valve;
- inlet\_valve;
- piston;
- user\_defined\_mechanical\_component.

**4.2.105.1 cylinder:** the descriptor which specifies that the mechanical component is of type cylinder.

**4.2.105.2 cylinder\_liner:** the descriptor which specifies that the mechanical component is of type cylinder liner.

**4.2.105.3 exhaust\_valve:** the descriptor which specifies that the mechanical component is of type exhaust valve.

**4.2.105.4 inlet\_valve:** the descriptor which specifies that the mechanical component is of type inlet valve.

**4.2.105.5 piston:** the descriptor which specifies that the mechanical component is of type piston.

**4.2.105.6 user\_defined\_mechanical\_component:** the descriptor, set by the user, which specifies the type of mechanical component if different from the other options.

## **4.2.106 Mechanical\_connection**

A Mechanical\_connection is a type of Mechanical\_product\_connection (see 4.2.113) which specifies the connection between two mechanical components (see 3.8.98).

The data associated with a Mechanical\_connection are the following:

- connection\_type.

The connection\_type attribute specifies the type of mechanical connection.

The value of the connection\_type shall be one of the following:

- shaft\_bearing\_interface;
- shaft\_component\_connection;
- shaft\_shaft\_connection.

**4.2.106.1 shaft\_bearing\_interface:** the descriptor which specifies that the mechanical connection is an interface between a shaft and a bearing.

**4.2.106.2 shaft\_component\_connection:** the descriptor which specifies that the mechanical connection is between a shaft and another component type.

**4.2.106.3 shaft\_shaft\_connection:** the descriptor which specifies that the mechanical connection is between two shafts.

## **4.2.107 Mechanical\_equipment**

A Mechanical\_equipment is a type of MP\_equipment (see 4.2.122) which specifies the high level concept for all the ship's mechanical equipments (see 3.8.100) which need to be defined.

The data associated with a Mechanical\_equipment are the following:

- type\_of.

The type\_of attribute specifies the type\_of mechanical equipment.

#### **4.2.108 Mechanical\_machinery**

A Mechanical\_machinery is a type of Machinery (see 4.2.88) and specifies the high level concept for all types of mechanical machinery (see 3.8.101) which need to be defined.

The data associated with a Mechanical\_machinery are the following:

- mechanical\_machinery\_type.

The mechanical\_machinery\_type attribute specifies the type of mechanical machinery.

The value of mechanical\_machinery\_type shall be one of the following:

- reciprocating\_machinery;
- rotating\_machinery.

**4.2.108.1 reciprocating\_machinery:** the descriptor which specifies that the mechanical machinery is of type reciprocating machinery.

**4.2.108.2 rotating\_machinery:** the descriptor which specifies that the mechanical machinery is of type rotating machinery.

#### **4.2.109 Mechanical\_machinery\_composition**

A Mechanical\_machinery\_composition is a type of Product\_composition (see 4.2.148) and specifies the high level concept for all the product composition (see 3.8.26) data which are attributable to all types of mechanical machinery.

The data associated with a Mechanical\_machinery\_composition are the following:

- defined\_for;
- list\_of\_auxiliary\_systems.

##### **4.2.109.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical machinery for which the definitions are defined.

##### **4.2.109.2 list\_of\_auxiliary\_systems**

The `list_of_auxiliary_systems` attribute specifies all the auxiliary systems (see 3.8.11) needed for the mechanical machinery. The `list_of_auxiliary_systems` is a DERIVED attribute from the higher level product structure definitions.

#### **4.2.110 Mechanical\_machinery\_identification**

A `Mechanical_machinery_identification` is a type of `MP_equipment_identification` (see 4.2.124) and specifies the concept for collecting all the definitions which are attributable to the identification of all types of mechanical machinery.

The data associated with a `Mechanical_machinery_identification` are the following:

- `defined_for`;
- `licence_number`;
- `licensor`.

##### **4.2.110.1 defined\_for**

The `defined_for` attribute specifies a set of one to many mechanical machinery for which the definitions are defined.

##### **4.2.110.2 licence\_number**

The `licence_number` attribute specifies the machinery manufacturing licence number in the form of a label.

##### **4.2.110.3 licensor**

The `licensor` attribute specifies the organisation under whose licence the machinery is being manufactured.

#### **4.2.111 Mechanical\_product**

A `Mechanical_product` is a type of `Item` (see 4.2.74) which provides the high level concept for all the mechanical products (see 3.8.103) which need to be defined or described.

The data associated with a `Mechanical_product` are the following:

- `standard_definition`;
- `standard_name`;
- `task_in_context`;
- `version_id`.

##### **4.2.111.1 standard\_definition**

The `standard_definition` attribute specifies a textual definition of the mechanical product. The standard definition shall be according to this part of ISO 10303.

##### **4.2.111.2 standard\_name**



The `standard_name` attribute specifies the standard name of the mechanical product. The standard name shall be according to this part of ISO 10303.

#### **4.2.111.3 task\_in\_context**

The `task_in_context` attribute specifies the tasks which are related to this mechanical product by referencing the Task (see 4.2.189) application object.

#### **4.2.111.4 version\_id**

The `version_id` attribute specifies a simple mechanism for version identification of the mechanical product.

### **4.2.112 Mechanical\_product\_component**

A `Mechanical_product_component` is a type of `Mechanical_product` (see 4.2.111) which specifies the high level concept for all the components (see 3.8.25) which need to be defined or described.

The data associated with a `Mechanical_product_component` are the following:

- `part_of`.

The `part_of` attribute specifies the belonging of the component to either a mechanical system (see 3.8.104) or a mechanical equipment (see 3.8.58).

### **4.2.113 Mechanical\_product\_connection**

A `Mechanical_product_connection` is a type of `Product_connection` (see 4.2.149) and a type of `Mechanical_product_relationship` (see 4.2.116) and specifies the high level concept for all the definitions which relate to connection (see 3.8.34) of a mechanical product to another item.

The data associated with a `Mechanical_product_connection` are the following:

- `connecting_components`;
- `connection_characteristics`;
- `connection_specifications`;
- `connector_1`;
- `connector_2`.

#### **4.2.113.1 connecting\_components**

The `connecting_components` attribute specifies all the connecting components (see 3.8.33) required in order to realise the connection.

#### **4.2.113.2 connection\_characteristics**

The `connection_characteristics` attribute specifies all the operational and functional characteristics for the connection.

### 4.2.113.3 connection\_specifications

The connection\_specifications attribute specifies all the engineering specifications (geometric, non-geometric, installation procedure, ...) for the connection.

### 4.2.113.4 connector\_1

The connector\_1 attribute specifies the first connector (see 3.8.35) for the connection.

### 4.2.113.5 connector\_2

The connector\_2 attribute specifies the second connector (see 3.8.35) for the connection.

## 4.2.114 Mechanical\_product\_drawing

A Mechanical\_product\_drawing is a type of Mechanical\_product\_representation (see 4.2.117) and specifies the geometric representation of mechanical product in the form of one to many CAD drawings together with identification of the drawing configuration.

The data associated with a Mechanical\_product\_drawing are the following:

- defined\_for;
- drawing;
- drawing\_configurations.

### 4.2.114.1 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which drawing is defined.

### 4.2.114.2 drawing

The drawing attribute specifies the representation of mechanical product in the form of a CAD drawing. This is supported through use of a Geometric\_representation\_item (see 4.2.68) as defined in ISO 10303-42.

### 4.2.114.3 drawing\_configurations

The drawing\_configurations attribute specifies all the information which is necessary for identification of a drawing

## 4.2.115 Mechanical\_product\_general\_characteristic

A Mechanical\_product\_general\_characteristic is a type of Definition (see 4.2.30) and specifies the high level concept for all the definitions which are attributable to the general characteristics (see 3.8.77) of the mechanical product.

The data associated with a Mechanical\_product\_general\_characteristic are the following:

- defined\_for;
- functions;
- mass\_weight\_inertia;
- material;
- overall\_dimensions.

#### **4.2.115.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which the general characteristics are defined.

#### **4.2.115.2 functions**

The functions attribute specifies the functionality of the mechanical product through referencing the Function\_definition (see 4.2.61) application object.

#### **4.2.115.3 mass\_weight\_inertia**

The mass\_weight\_inertia attribute specifies the mass\_related data through referencing the Mass\_weight\_inertia (see 4.2.102) application object.

#### **4.2.115.4 material**

The material attribute specifies the material\_related data through referencing the Product\_material (see 4.2.153) application object.

#### **4.2.115.5 overall\_dimensions**

The overall\_dimensions attribute specifies the overall dimensions of the product through referencing the Overall\_dimension (see 4.2.132) application object.

### **4.2.116 Mechanical\_product\_relationship**

A Mechanical\_product\_relationship defines the relationship and association between two mechanical products.

The data associated with a Mechanical\_product\_relationship are the following:

- major\_aspect\_of\_relationship;
- mechanical\_product\_1;
- mechanical\_product-2.

#### **4.2.116.1 major\_aspect\_of\_relationship**

The major\_aspect\_of\_relationship specifies a description of how the two mechanical products are related together.

### 4.2.116.2 mechanical\_product\_1

The mechanical\_product\_1 attribute specifies the first mechanical product which takes part in the relationship.

### 4.2.116.3 mechanical\_product\_2

The mechanical\_product\_2 attribute specifies the second mechanical product which takes part in the relationship.

## 4.2.117 Mechanical\_product\_representation

A Mechanical\_product\_representation is a type of Geometric\_definition (see 4.2.67) and specifies the concept for detailed geometry of a mechanical product. A Mechanical\_product\_representation is either a Mechanical\_product\_shape\_representation (see 4.2.118) or a Mechanical\_product\_drawing (see 4.2.114).

## 4.2.118 Mechanical\_product\_shape\_representation

A Mechanical\_product\_shape\_representation is a type of Mechanical\_product\_representation (see 4.2.117) and specifies the external shape of a mechanical product.

The data associated with a Mechanical\_product\_shape\_representation are the following:

- defined\_for;
- shape\_solid.

### 4.2.118.1 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which shape is defined.

### 4.2.118.2 shape\_solid

The shape\_solid attribute specifies the external shape representation of the mechanical product in the form of a solid model (see 3.8.144). The shape representation is supported by Solid\_model (see 4.2.180).

## 4.2.119 Mechanical\_system

A Mechanical\_system is a type of Mechanical\_product (see 4.2.111) which provides the high level concept for all the mechanical systems (see 3.8.104) which need to be defined or described.

The data associated with a Mechanical\_system are the following:

- functionality.

The functionality attribute specifies the basic function of a mechanical system.

The value of functionality shall be one of the following:

- electric\_power\_generation;
- mechanical\_power\_generation;
- mechanical\_power\_transmission;
- propulsion;
- steam\_generation;
- user\_defined\_functionality.

**4.2.119.1 electric\_power\_generation:** the descriptor which specifies the underlying functionality of the system to be electric power generation.

**4.2.119.2 mechanical\_power\_generation:** the descriptor which specifies the underlying functionality of the system to be mechanical power generation.

**4.2.119.3 mechanical\_power\_transmission:** the descriptor which specifies the underlying functionality of the system to be mechanical power transmission.

**4.2.119.4 propulsion:** the descriptor which specifies the underlying functionality of the system to be propulsion.

**4.2.119.5 steam\_generation:** the descriptor which specifies the underlying functionality of the system to be steam generation.

**4.2.119.6 user\_defined\_functionality:** the descriptor, set by the user, which specifies the underlying function of the system if different from the other options.

## **4.2.120 Mechanical\_transmission\_system**

A Mechanical\_transmission\_system is a type of Mechanical\_system (see 4.2.119) which specifies the high level concept for all the mechanical transmission systems (see 3.8.105) which need to be defined.

The data associated with a Mechanical\_transmission\_system are the following:

- type\_of.

The type\_of attribute specifies the type of transmission system.

## **4.2.121 Metallic\_impurity**

A Metallic\_impurity specifies the name and level of each metallic-type impurity.

The data associated with a Metallic\_impurity are the following:

- metal\_name;
- metallic\_content\_percent.

### **4.2.121.1 metal\_name**

The metal\_name attribute specifies the name of the metal.

The value of metal\_name shall be one of the following:

- iron;
- potassium;
- sodium;
- user\_defined\_metal.

**4.2.121.1.1 iron:** the descriptor which specifies that the metallic impurity is iron.

**4.2.121.1.2 potassium:** the descriptor which specifies that the metallic impurity is potassium.

**4.2.121.1.3 Sodium:** the descriptor which specifies that the metallic impurity is sodium.

**4.2.121.1.4 user\_defined\_metal:** the descriptor, set by the user, which specifies the name of a metal if different from the other options.

## **4.2.121.2 metallic\_content\_percent**

The metallic\_content\_percent specifies the level of impurity in percentage.

## **4.2.122 MP\_equipment**

A MP\_equipment is a type of Mechanical\_product (see 4.2.111) and specifies the high level concept for all the equipments (see 3.8.58) which need to be defined.

The data associated with a MP\_equipment are the following:

- name\_manufacturer\_specific;
- name\_user\_specific.

### **4.2.122.1 name\_manufacturer\_specific**

The name\_manufacturer\_specific attribute specifies the name of the equipment as used by the manufacturer.

### **4.2.122.2 name\_user\_specific**

The name\_user\_specific attribute specifies the name of the equipment according to the user.

## **4.2.123 MP\_equipment\_general\_characteristic**

A MP\_equipment\_general\_characteristic is a type of Mechanical\_product\_general\_characteristic (see 4.2.115) and specifies the high level concept for all the general characteristics data which need to be attributed to all the equipments.

The data associated with a MP\_equipment\_general\_characteristic are the following:

- date\_of\_manufacture;
- date\_placed\_in\_service;
- function;

- type\_of\_duty.

#### 4.2.123.1 date\_of\_manufacture

The date\_of\_manufacture attribute specifies the date when the equipment was manufactured.

#### 4.2.123.2 date\_placed\_in\_service

The date\_placed\_in\_service attribute specifies the date when the equipment was initially placed in service and operation.

#### 4.2.123.3 function

The function attribute specifies the underlying function (see 3.8.70) of the equipment.

The value of function shall be one of the following:

- electric\_generation;
- fluid\_distribution;
- fluid\_mover;
- heat\_exchange;
- lifting;
- prime\_mover;
- user\_defined.

**4.2.123.3.1 electric\_generation:** the descriptor which specifies the underlying role of the equipment as an electric generator.

**4.2.123.3.2 fluid\_distribution:** the descriptor which specifies the underlying role of the equipment as a fluid distributor (see 3.8.65).

**4.2.123.3.3 fluid\_mover:** the descriptor which specifies the underlying role of the equipment as being a fluid mover (see 3.8.66).

**4.2.123.3.4 heat\_exchange:** the descriptor which specifies the underlying role of the equipment as being a heat exchanger (see 3.8.78).

**4.2.123.3.5 lifting:** the descriptor which specifies the underlying role of the equipment as being lifting equipment.

**4.2.123.3.6 prime\_mover:** the descriptor which specifies the underlying role of the equipment as being a prime mover (see 3.8.120).

**4.2.123.3.7 user\_defined:** the descriptor, set by the user, which specifies the function of the equipment if different from the other options.

#### 4.2.123.4 type\_of\_duty

The type\_of\_duty attribute specifies the underlying duty of equipment.

The value of type\_of\_duty shall be one of the following:

- auxiliary\_equipment;
- deck\_equipment;
- main\_equipment.

**4.2.123.4.1 auxiliary\_equipment:** the descriptor which specifies the equipment to be one of the ship's auxiliary equipment.

**4.2.123.4.2 deck\_equipment:** the descriptor which specifies the equipment to be one of the ship's deck machinery.

**4.2.123.4.3 main\_equipment:** the descriptor which specifies the equipment to be one of the ship's main equipment.

#### 4.2.124 MP\_equipment\_identification

A MP\_equipment\_identification is a type of Product\_identification (see 4.2.152) and specifies the concept for collecting all the definitions which are attributable to the identification of the equipment.

The data associated with a MP\_equipment\_identification are the following:

- acquisition-code;
- category\_code;
- id\_manufacture\_specific;
- id\_user\_specific;
- model\_number;
- model\_type;
- nameplate\_data;
- place\_of\_manufacture.

##### 4.2.124.1 acquisition\_code

The acquisition\_code attribute specifies the equipment acquisition code (see 3.8.1).

##### 4.2.124.2 category\_code

The category\_code attribute specifies the category code of the equipment.

##### 4.2.124.3 id\_manufacturer\_specific

The id\_manufacturer\_specific attribute specifies the equipment identification by the manufacturer or supplier.



#### 4.2.124.4 id\_user\_specific

The id\_user\_specific attribute specifies the equipment identification number by user.

#### 4.2.124.5 model\_number

The model\_number attribute specifies the model number of the equipment.

#### 4.2.124.6 model\_type

The model\_type attribute specifies the model type of the equipment.

#### 4.2.124.7 nameplate\_data

The nameplate\_data attribute specifies the information content as appears on the equipment nameplate in a text format.

#### 4.2.124.8 place\_of\_manufacture

The place\_of\_manufacture attribute specifies the place of manufacture of the equipment.

### 4.2.125 MP\_piping\_system

A MP\_piping\_system is a type of Mechanical\_system (see 4.2.119) which provides the high level concept for all the piping systems which need to be defined.

The data associated with a MP\_piping\_system are the following:

- piping\_system\_type.

The piping\_system\_type attribute specifies the type of the piping system.

The value of piping\_system\_type shall be one of the following:

- bilge\_water\_system;
- compressed\_air\_system;
- cooling\_water\_system;
- fresh\_water\_system;
- fuel\_injection\_system;
- fuel\_oil\_system;
- lube\_oil\_system;
- user\_defined\_piping\_system.

**4.2.125.1 bilge\_water\_system:** the descriptor which specifies that the piping system is a bilge water system.

**4.2.125.2 compressed\_air\_system:** the descriptor which specifies that the piping system is a compressed air system.

**4.2.125.3 cooling\_water\_system:** the descriptor which specifies that the piping system is a cooling water system.

**4.2.125.4 fresh\_water\_system:** the descriptor which specifies that the piping system is a fresh water system.

**4.2.125.5 fuel\_injection\_system:** the descriptor which specifies that the piping system is a fuel injection system.

**4.2.125.6 fuel\_oil\_system:** the descriptor which specifies that the piping system is a fuel oil system.

**4.2.125.7 lube\_oil\_system:** the descriptor which specifies that the piping system is a lubrication system.

**4.2.125.8 user\_defined\_piping\_system:** the descriptor, set by the user, which specifies the type of piping system if different from the other options.

## **4.2.126 Operating\_point**

An `Operating_point` specifies a machinery operating condition in terms of machinery power, rotational speed and efficiency. This operating condition has significance from the machinery function design and operational point of view.

The data associated with an `Operating_point` are the following:

- description;
- efficiency;
- power;
- rotational\_speed.

### **4.2.126.1 description**

The `description` attribute specifies a textual description of the operating point.

### **4.2.126.2 efficiency**

The `efficiency` attribute specifies the machinery efficiency at the operating point.

### **4.2.126.3 power**

The `power` attribute specifies the machinery power at the operating point.

### **4.2.126.4 rotational\_speed**

The `rotational_speed` attribute specifies the machinery rotational speed at the operating point.

## **4.2.127 Operation\_task**

An `Operation_task` is a type of `Task` (see 4.2.189) and specifies the concept for collecting data which are attributable to an operation task.

The data associated with an `Operation_task` are the following:

- `type_of_task`.

The `type_of_task` attribute specifies the type of operation task in a text format.

#### **4.2.128 Operational\_characteristic**

An `Operational_characteristic` is a type of `Functional_characteristic` (see 4.2.60) and specifies the high level concept for all the definitions (see 3.8.43) which are attributable to operational aspects of a mechanical product.

The data associated with an `Operational_characteristic` are the following:

- `defined_for`;
- `operation_status`.

##### **4.2.128.1 defined\_for**

The `defined_for` attribute specifies a set of one to many mechanical products for which operational data are defined.

##### **4.2.128.2 operation\_status**

The `operation_status` attribute specifies the operating condition of the mechanical product in a text format.

#### **4.2.129 Organization**

An `Organization` specifies the details of the referenced organisation. It is used as defined in ISO 10303-41.

#### **4.2.130 Organizational\_project**

An `Organizational_project` specifies the details of the referenced project. It is used as defined in ISO 10303-41.

#### **4.2.131 Other\_task**

An `Other_task` is a type of `Task` (see 4.2.189) and specifies the concept for collecting data which are attributable to any user defined task not explicitly defined in other application objects.

The data associated with an `Other_task` are the following:

- `type_of_task`.

The `type_of_task` attribute specifies the type of the task in a text format.

### 4.2.132 Overall\_dimension

An Overall\_dimension is a type of Geometric\_definition (see 4.2.67) and specifies and collects the overall length, breadth and height of a mechanical product.

The data associated with an Overall\_dimension are the following:

- defined\_for;
- overall\_breadth;
- overall\_height;
- overall\_length.

#### 4.2.132.1 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which dimensional data are defined.

#### 4.2.132.2 overall\_breadth

The overall\_breadth attribute specifies the overall breadth of the mechanical product.

#### 4.2.132.3 overall\_height

The overall\_height attribute specifies the overall height of the mechanical product.

#### 4.2.132.4 overall\_length

The overall\_length attribute specifies the overall length of the mechanical product.

### 4.2.133 Person

A Person specifies the details of a person which needs to be identified. It is used as defined in ISO 10303-41.

### 4.2.134 Person\_and\_organization

A Person\_and\_organization specifies the details of a person and his/her affiliated organisation. It is used as defined in ISO 10303-41.

### 4.2.135 Physical\_definition

A Physical\_definition is a type of Definition (see 4.2.30) and specifies the high level concept for all the definitions attributable to the physical (see 3.8.111) aspects of a mechanical product.

### 4.2.136 Pipe

A Pipe is a type of Piping\_component (see 4.2.137) and specifies the data representation concept for all the pipes which need to be defined.

The data associated with a pipe are the following:

- pipe\_type.

The pipe\_type attribute specifies the type of pipe in text format.

#### 4.2.137 Piping\_component

A Piping\_component is a type of Mechanical\_product\_component (see 4.2.112) and specifies the high level concept for all the piping components which need to be defined.

The data associated with a Piping\_component are the following:

- piping\_component\_type.

The piping\_component\_type attribute specifies the type of piping component.

#### 4.2.138 Piping\_connection

A Piping\_connection is a type of Mechanical\_product\_connection (see 4.2.113) which specifies the connection between a mechanical connector (see 3.8.99) and a piping connector (see 3.8.112) or between two piping connectors.

The data associated with a Piping\_connection are the following:

- connection\_type.

The connection\_type attribute specifies the type of piping connection.

The value of the connection\_type shall be one of the following:

- butt;
- flanged;
- flared;
- screwed;
- socketed;
- union;
- user\_defined\_piping\_connection\_type;
- welded.

**4.2.138.1 butt:** the descriptor which specifies that the piping connection is of type butt welded.

**4.2.138.2 flanged:** the descriptor which specifies the piping connection is of type flanged.

**4.2.138.3 flared:** the descriptor which specifies the piping connection is of type flared.

**4.2.138.4 screwed:** the descriptor which specifies the piping connection is of type screwed.

**4.2.138.5 socketed:** the descriptor which specifies the piping connection is of type socketed.

**4.2.138.6 union:** the descriptor which specifies the piping connection is of type union.

**4.2.138.7 user\_defined\_piping\_connection\_type:** the descriptor, set by the user, which specifies the type of piping connection if different from the other options.

**4.2.138.8 welded:** the descriptor which specifies the piping connection is of type welded.

## **4.2.139 Piping\_equipment**

A Piping\_equipment is a type of MP\_equipment (see 4.2.122) which provides the high level concept for all the ship's piping equipment (see 3.8.113) which needs to be defined.

The data associated with a Piping\_equipment are the following:

- piping\_equipment\_type.

The piping\_equipment\_type attribute specifies the basic types of piping equipment.

The value of piping\_equipment\_type shall be one of the following:

- pressure\_vessel;
- tank;
- valve;
- user\_defined\_piping\_equipment\_type.

**4.2.139.1 pressure\_vessel:** the descriptor which specifies that the piping equipment is a pressure vessel.

**4.2.139.2 tank:** the descriptor which specifies that the piping equipment is a tank.

**4.2.139.3 valve:** the descriptor which specifies that the piping equipment is a valve.

**4.2.139.4 user\_defined\_piping\_equipment\_type:** the descriptor, set by the user, which specifies the type of piping equipment if different from the other options.

## **4.2.140 Piston**

A Piston is a type of Mechanical\_component (see 4.2.105) and specifies the data representation concept for all the pistons which need to be defined.

The data associated with a Piston are the following:

- piston\_type.

The piston\_type attribute specifies the type of piston in text format.

#### 4.2.141 Plane\_angle

A Plane\_angle is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is a plane angle as defined in ISO 31 (clause 2).

The data associated with a Plane\_angle are the following:

- plane\_angle\_unit.

The plane\_angle\_unit attribute specifies all the units in which plane angles are measured.

#### 4.2.142 Power

A Power is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is power (energy per time).

The data associated with a Power are the following:

- power\_unit.

The power\_unit attribute specifies all the units in which the physical quantity of power is measured.

#### 4.2.143 Power\_speed\_pitch\_point

A Power\_speed\_pitch\_point is a type of Operating\_point (see 4.2.126) and specifies an operating condition of a screw propeller in terms of its power, rotational speed, pitch and efficiency.

The data associated with a Power\_speed\_pitch\_point are the following:

- pitch.

The pitch attribute specifies the propeller pitch for the operating condition.

#### 4.2.144 Pressure

A Pressure is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is pressure (force per area).

The data associated with a Pressure are the following:

- pressure\_unit.

The pressure\_unit attribute specifies all the units in which the physical quantity of pressure is measured.

#### 4.2.145 Process\_equipment

A Process\_equipment is a type of MP\_equipment (see 4.2.122) which specifies the high level concept for all the ship's process equipments (see 3.8.121) which need to be defined.

The data associated with a Process\_equipment are the following:

- process\_equipment\_type.

The process\_equipment\_type attribute specifies the basic type of the process equipment.

#### **4.2.146 Product\_anomaly**

A Product\_anomaly is a type of Definition (see 4.2.30) and specifies the high level concept for all the definitions attributable to all types of product anomalies (see 3.8.6).

The data associated with a Product\_anomaly are the following:

- anomaly\_cause;
- anomaly\_description;
- anomaly\_related\_tasks;
- date\_anomaly\_discovered;
- date\_anomaly\_happened;
- date\_anomaly\_rectified.

##### **4.2.146.1 anomaly\_cause**

The anomaly\_cause attribute specifies the cause of the anomaly in text format.

##### **4.2.146.2 anomaly\_description**

The anomaly\_description attribute specifies a description of the anomaly in text format.

##### **4.2.146.3 anomaly\_related\_tasks**

The anomaly\_related\_tasks attribute specifies a set of tasks which relate to an anomaly.

##### **4.2.146.4 date\_anomaly\_discovered**

The date\_anomaly\_discovered attribute specifies the date at which the anomaly has been discovered.

##### **4.2.146.5 date\_anomaly\_happened**

The date\_anomaly\_happened attribute specifies the date at which the anomaly has occurred.

##### **4.2.146.6 date\_anomaly\_rectified**

The date\_anomaly\_rectified attribute specifies the date at which the anomaly has been rectified through corrective action.

#### **4.2.147 Product\_assembly**

A Product\_assembly is a type of Product\_structure\_definition (see 4.2.157) which specifies the high level concept for all the information which defines the assembly of the mechanical product .



The data associated with a Product\_assembly are the following:

- assembly\_defined\_by\_relationships;
- defined\_for;
- method\_of\_assembly.

#### **4.2.147.1 assembly\_defined\_by\_relationships**

The assembly\_defined\_by\_relationships attribute specifies all the relationships between the constituent items of the mechanical product.

#### **4.2.147.2 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which assembly data are defined.

#### **4.2.147.3 method\_of\_assembly**

The method\_of\_assembly attribute specifies the information which describes the method of assembly and disassembly in the form of documents.

### **4.2.148 Product\_composition**

A Product\_composition is a type of Product\_structure\_definition (see 4.2.157) which specifies the high level concept for all the definitions which relate to the composition (see 3.8.26) of a mechanical product .

The data associated with a Product\_composition are the following:

- composed\_of;
- defined\_for;
- no\_of\_each\_component.

#### **4.2.148.1 composed\_of**

The composed\_of attribute specifies details of a set of mechanical products which are members of composition (see 3.8.26) for this mechanical product.

#### **4.2.148.2 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which product composition data are defined.

#### **4.2.148.3 no\_of\_each\_component**

The no\_of\_each\_component attribute specifies the number of each mechanical product in the composition. The no\_of\_each\_component is a DERIVED attribute.

## 4.2.149 Product\_connection

A Product\_connection specifies the high level concept for all the information which define the connection (see 3.8.34) of two mechanical products.

The data associated with a Product\_connection are the following:

- connection\_type;
- relates\_to.

### 4.2.149.1 connection\_type

The connection\_type attribute specifies the type of connection.

The value of connection\_type shall be one of the following:

- electrical\_connection;
- mechanical\_connection;
- piping\_connection;
- structural\_connection;
- user\_defined\_connection\_type.

**4.2.149.1.1 electrical\_connection:** the descriptor which specifies that the connection is of type electrical connection.

**4.2.149.1.2 mechanical\_connection:** the descriptor which specifies that the connection is of type mechanical connection.

**4.2.149.1.3 piping\_connection:** the descriptor which specifies that the connection is of type piping connection.

**4.2.149.1.4 structural\_type:** the descriptor which specifies that the connection is of type structural type.

**4.2.149.1.5 user\_defined\_connection\_type:** the descriptor, set by the user, which specifies the type of connection if different from the other options.

### 4.2.149.2 relates\_to

The relates\_to attribute specifies the relation between a product connection and a product connectivity (see 3.8.124) through reference to Product\_connectivity (see 4.2.150) application object.

## 4.2.150 Product\_connectivity

A Product\_connectivity is a type of Product\_structure\_definition (see 4.2.157) and specifies the high level concept for all the definitions which relate to product connectivity (see 3.8.124) of a mechanical product.

The data associated with a Product\_connectivity are the following:

- defined\_for;
- no\_of\_connections;
- product\_connections;
- product\_connectivity\_specifications;
- product\_is\_connected\_to.

#### **4.2.150.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which connectivity data are defined.

#### **4.2.150.2 no\_of\_connections**

The no\_of\_connections attribute specifies the total number of connections of the mechanical product. The no\_of\_connections is a DERIVED attribute.

#### **4.2.150.3 product\_connections**

The product\_connections attribute specifies all types of connection for the product by referencing the Product\_connection (see 4.2.149) application object.

#### **4.2.150.4 product\_connectivity\_specifications**

The product\_connectivity\_specifications attribute specifies the overall specification of the connectivity by referencing external documents.

#### **4.2.150.5 product\_is\_connected\_to**

The product\_is\_connected\_to attribute specifies all the mechanical products which are connected to this mechanical product.

### **4.2.151 Product\_context**

A Product\_context is a type of Configuration definition (see 4.2.12) and specifies the data which define the context within which a mechanical product is used or considered.

The data associated with a Product\_context are the following:

- defined\_for;
- owner\_in\_context;
- project\_in\_context;
- ship\_in\_context.

#### **4.2.151.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which the context data are defined.

#### **4.2.151.2 owner\_in\_context**

The owner\_in\_context attribute specifies the organisations which own the mechanical product.

#### **4.2.151.3 project\_in\_context**

The project\_in\_context attribute specifies the projects associated with the mechanical product.

#### **4.2.151.4 ship\_in\_context**

The ship\_in\_context attribute specifies the ships associated with the mechanical product.

### **4.2.152 Product\_identification**

A Product\_identification is a type of Configuration\_definition (see 4.2.12) and specifies the high level data needed for identification of a mechanical product.

The data associated with a Product\_identification are the following:

- defined\_for;
- manufacturer;
- serial\_number;
- tag\_number;
- user\_id.

#### **4.2.152.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which identification data are defined.

#### **4.2.152.2 manufacturer**

The manufacturer attribute specifies the details of the organisation which is the manufacturer of the mechanical product.

#### **4.2.152.3 serial\_number**

The serial\_number attribute specifies the manufacturer's serial number in the form of a label.

#### **4.2.152.4 tag\_number**

The tag\_number attributes specifies the mechanical product's tag number in the form of a label.

#### **4.2.152.5 user\_id**

The user\_id attribute specifies a user-defined identification in text format.

### 4.2.153      **Product\_material**

A Product\_material is a type of Physical\_definition (see 4.2.135) which provides the concept for identification of the solid materials from which a mechanical product is made of.

The data associated with a Product\_material are the following:

- defined\_for;
- documented\_definitions;
- material\_code;
- material\_description;
- material\_name.

#### 4.2.153.1    **defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which material data are defined.

#### 4.2.153.2    **documented\_definitions**

The documented\_definitions attribute specifies references to the documents which define the properties of the material.

#### 4.2.153.3    **material\_code**

The material\_code attribute specifies an identification code for the material in the form of a label.

#### 4.2.153.4    **material\_description**

The material\_description attribute specifies a description of the material in a text form.

#### 4.2.153.5    **material\_name**

The material\_name attribute specifies the name of the material in the form of a label.

### 4.2.154      **Product\_participation**

A Product\_participation is a type of Product\_structure\_definition (see 4.2.157) which specifies the high level concept for all the definitions which relate to the belonging of a mechanical product to another higher level mechanical product in the decomposition hierarchy (see 3.8.42).

The data associated with a Product\_participation are the following:

- defined\_for;
- product\_is\_part\_of.

#### **4.2.154.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which participation data are defined.

#### **4.2.154.2 product\_is\_part\_of**

The product\_is\_part\_of attribute specifies the higher level mechanical product in the decomposition hierarchy, which this mechanical product is part of it.

### **4.2.155 Product\_placement**

A Product\_placement is a type of Product\_structure\_definition (see 4.2.157) which specifies the high level concept for all the definitions which relate to position and orientation of mechanical product.

The data associated with a Product\_placement are the following:

- defined\_for;
- orientation;
- placed\_in;
- place\_by\_coordinate;
- ship\_side.

#### **4.2.155.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which product placement and location data are defined.

#### **4.2.155.2 orientation**

The orientation attribute specifies the orientation of the mechanical product in a text format.

#### **4.2.155.3 placed\_in**

The placed\_in attribute specifies the compartment and/or space of the ship within which the mechanical product is located through a reference to Ship\_space (see 4.2.178) application object.

#### **4.2.155.4 place\_by\_coordinate**

The place\_by\_coordinate attribute specifies the position of the mechanical product within the context of a local coordinate system.

#### **4.2.155.5 ship\_side**

The ship\_side attribute specifies the position and/or orientation of the mechanical product according to the side of the ship where it is located.

The value of ship\_side shall be one of the following:

- aft;
- fore;
- user\_defined\_side\_of\_ship.

**4.2.155.5.1 aft:** The descriptor which specifies the side of the ship as aft (see 3.8.3).

**4.2.155.5.2 fore:** The descriptor which specifies the side of ship as fore (see 3.8.67).

**4.2.155.5.3 user\_defined\_side\_of\_ship:** The descriptor, set by the user, which specifies the side of ship if different from the other options.

## **4.2.156 Product\_status**

A Product\_status is a type of configuration\_definition (see 4.2.12) and specifies the data which define the life cycle status of a mechanical product.

The data associated with a Product\_status are the following:

- defined\_for;
- life\_cycle\_phase;
- reality\_status.

### **4.2.156.1 defined\_for**

The defined\_for attribute specifies a set of one to many mechanical products for which product status data are defined.

### **4.2.156.2 life\_cycle\_phase**

The life\_cycle\_phase attribute specifies the life cycle phase of the mechanical product.

The value of life\_cycle\_phase shall be one of the following:

- design\_phase;
- disposal\_phase;
- installation\_phase;
- manufacturing\_phase;
- operation\_phase;
- specification\_phase.

**4.2.156.2.1 design\_phase:** the descriptor which specifies that the product is at its design lifecycle phase.

**4.2.156.2.2 disposal\_phase:** the descriptor which specifies that the product is at its disposal phase.

**4.2.156.2.3 installation\_phase:** the descriptor which specifies that the product is at its installation phase.

**4.2.156.2.4 manufacturing\_phase:** the descriptor which specifies that the product is at its manufacturing phase.

**4.2.156.2.5 operation\_phase:** the descriptor which specifies that the product is at its operation phase.

**4.2.156.2.6 specification\_phase:** the descriptor which specifies that the product is at its specification phase.

### **4.2.156.3 reality\_status**

The `reality_status` attribute specifies whether the mechanical product is a conceptual, planned, manufactured or disposed product.

The value of `reality_status` phase shall be one of the following:

- conceptual;
- designed;
- disposed;
- planned;
- real.

**4.2.156.3.1 conceptual:** the descriptor which specifies that the product is at concept level.

**4.2.156.3.2 designed:** the descriptor which specifies that the product is at design level.

**4.2.156.3.3 disposed:** the descriptor which specifies that the product is at the disposal stage.

**4.2.156.3.4 planned:** the descriptor which specifies that the product is at the planning stage.

**4.2.156.3.5 real:** the descriptor which specifies that the product is a physically realised thing.

### **4.2.157 Product\_structure\_definition**

A `Product_structure_definition` is a type of `Definition` (see 4.2.30) and specifies the high level concept for all the definitions (see 3.8.43) which are attributable to product structure (see 3.8.125).

The data associated with a `Product_structure_definition` are the following:

- `usage_context`.

The `usage_context` attribute specifies the context for the use of the product structure information.

### **4.2.158 Propulsion\_system**

A `Propulsion_system` is a type of `Mechanical_system` (see 4.2.119) and specifies the high level concept for all the ship's propulsion systems (see 3.8.126) which need to be defined or described.

The data associated with a `Propulsion_system` are the following:

- `propulsion_system_type`.



The `propulsion_system_type` attribute specifies the type of propulsion system.

The value of `propulsion_system_type` shall be one of the following:

- `electrical_propulsion_system`;
- `mechanical_propulsion_system`.

**4.2.158.1 `electrical_propulsion_system`:** the descriptor which specifies that the propulsion system is of type electrical and the propulsor is driven by an electric motor.

**4.2.158.2 `mechanical_propulsion_system`:** the descriptor which specifies that the propulsion system is of type mechanical and the propulsor is driven by a prime mover via a mechanical transmission system.

## **4.2.159 `RAM_characteristic`**

A `RAM_characteristic` specifies the concept for collecting all the reliability, availability and maintainability characteristics (see 3.8.132) which are attributable to the RAM characteristics of a mechanical product.

The data associated with the `RAM_characteristic` are the following:

- `availability_data`;
- `defined_for`;
- `maintainability_data`;
- `reliability_data`.

### **4.2.159.1 `availability_data`**

The `availability_data` attribute collects all the availability-related data via referencing of the Availability (see 4.2.7) application object.

### **4.2.159.2 `defined_for`**

The `defined_for` attribute specifies the mechanical product for which the RAM characteristics are defined.

### **4.2.159.3 `maintainability_data`**

The `maintainability_data` attribute collects all the maintainability-related data via referencing of the Maintainability (see 4.2.93) application object.

### **4.2.159.4 `reliability_data`**

The `reliability_data` attribute specifies all the reliability-related data via referencing of the Reliability (see 4.2.165) application object.

## 4.2.160 Ratio

A Ratio is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is a ratio as defined in ISO 31 (clause 2).

The data associated with a Ratio are the following:

- ratio\_unit.

The ratio\_unit attribute specifies all the units in which the ratio of the two physical quantities, that are of the same kind, is measured.

## 4.2.161 Reciprocating\_machinery

A Reciprocating\_machinery is a type of Mechanical\_machinery (see 4.2.108) which provides the high level concept for all types of ship reciprocating machinery (see 3.8.133) which need to be defined.

The data associated with a Reciprocating\_machinery are the following:

- reciprocating\_machinery\_type.

The reciprocating\_machinery\_type attribute specifies the type of reciprocating machinery.

The value of reciprocating\_machinery\_type shall be one of the following:

- diesel\_engine;
- reciprocating\_compressors;
- reciprocating\_pump;
- spark\_ignition\_engine;
- user\_defined\_reciprocating\_machinery\_type.

**4.2.161.1 diesel\_engine:** the descriptor which specifies that the reciprocating machinery is of type diesel engine.

**4.2.161.2 reciprocating\_compressor:** the descriptor which specifies that the reciprocating machinery is of type reciprocating compressor.

**4.2.161.3 reciprocating\_pump:** the descriptor which specifies that the reciprocating machinery is of type reciprocating pump.

**4.2.161.4 spark\_ignition\_engine:** the descriptor which specifies that the reciprocating machinery is of type spark ignition engine.

**4.2.161.5 user\_defined\_reciprocating\_machinery\_type:** the descriptor, set by the user, which specifies the type of reciprocating machinery if different from the other options.

## 4.2.162 Reciprocating\_machinery\_composition

A `Reciprocating_machinery_composition` is a type of `Mechanical_machinery_composition` (see 4.2.109) and specifies the high level concept for all the product composition (see 3.8.26) data which are attributable to all types of reciprocating machinery.

The data associated with a `Reciprocating_machinery_composition` are the following:

- `defined_for`;
- `no_of_cylinders`.

#### **4.2.162.1 `defined_for`**

The `defined_for` attribute specifies a set of one to many reciprocating machinery for which the composition is defined.

#### **4.2.162.2 `no_of_cylinders`**

The `no_of_cylinders` attribute specifies the number of cylinders of the the reciprocating machinery. The `no_of_cylinders` is a DERIVED parameter from higher level product structure definitions.

### **4.2.163 `Reciprocating_machinery_general_characteristic`**

A `Reciprocating_machinery_general_characteristic` is a type of `Machinery_general_characteristic` (see 4.2.91) and specifies the high level concept for all the general characteristics data which need to be attributed to all types of the reciprocating machineries.

The data associated with a `Reciprocating_machinery_general_characteristic` are the following:

- `cylinder_cooling_method`;
- `defined_for`.

#### **4.2.163.1 `cylinder_cooling_method`**

The `cylinder_cooling_method` attribute specifies the cooling method for a cylinder.

The value of `cylinder_cooling_method` shall be one of the following:

- `air_cooled`;
- `user_defined_cooling_method`;
- `water_cooled`.

**4.2.163.1.1 `air_cooled`:** the descriptor which specifies that the cylinder is cooled by air.

**4.2.163.1.2 `user_defined_cooling_method`:** the descriptor, set by the user, which specifies the cylinder cooling method if different from the other options.

**4.2.163.1.3 water\_cooled:** the descriptor which specifies that the cylinder is cooled by water.

#### **4.2.163.2 defined\_for**

The defined\_for attribute specifies a set of one to many reciprocating machinery for which the definitions are defined.

### **4.2.164 Reciprocating\_machinery\_overall\_dimension**

A Reciprocating\_machinery\_overall\_dimension is a type of Overall\_dimension (see 4.2.132) and specifies the concept for collecting all the definitions which are attributable to the overall dimension of all types of reciprocating machinery.

The data associated with a Reciprocating\_machinery\_overall\_dimension are the following:

- compression\_ratio;
- cylinder\_bore;
- defined\_for;
- piston\_stroke.

#### **4.2.164.1 compression\_ratio**

The compression\_ratio attribute specifies the cylinder compression ratio (see 3.8.28) of reciprocating machinery.

#### **4.2.164.2 cylinder\_bore**

The cylinder\_bore attribute specifies the cylinder bore of reciprocating machinery.

#### **4.2.164.3 defined\_for**

The defined\_for attribute specifies a set of one to many reciprocating machinery for which the definitions are defined.

#### **4.2.164.4 piston\_stroke**

The piston\_stroke attribute specifies the piston stroke of reciprocating machinery.

### **4.2.165 Reliability**

A Reliability specifies the data which are attributable to reliability performance of a mechanical product.

The data associated with a Reliability are the following:

- failure\_rate;
- mean\_time\_between\_failure;
- mean\_time\_to\_failure;

– reliability.

#### **4.2.165.1 failure\_rate**

The failure\_rate attribute specifies the reliability performance of a mechanical product in terms of its mean failure rate (see 3.7).

#### **4.2.165.2 mean\_time\_between\_failure**

The mean\_time\_between\_failure attribute specifies the reliability performance of a mechanical product in terms of its mean time between failures.

#### **4.2.165.3 mean\_time\_to\_failure**

The mean\_time\_to\_failure attribute specifies the reliability performance of a mechanical product in terms of its mean time to failures.

#### **4.2.165.4 reliability**

The reliability attribute specifies the reliability of a mechanical product.

### **4.2.166 Rotating\_component**

A Rotating\_component is a type of Mechanical\_product\_component (see 4.2.112) and specifies the high level concept for all the rotating components which need to be defined.

The data associated with a Rotating\_component are the following:

- rotating\_component\_type.

The rotating\_component\_type specifies the type of rotating component.

### **4.2.167 Rotating\_machinery**

A Rotating\_machinery is a type of Mechanical\_machinery (see 4.2.108) which provides the high level concept for all the ship rotating non-electrical machineries which need to be defined.

The data associated with a Rotating\_machinery are the following:

- rotating\_machinery\_type.

The rotating\_machinery\_type attribute specifies the basic types of a rotating machinery.

The value of the rotating\_machinery\_type shall be one of the following:

- cycloidal\_propeller;
- gas\_turbine;
- screw\_propeller;
- steam\_turbine;
- supercharger;

- turbocharger;
- user\_defined\_rotating\_machinery\_type.

**4.2.167.1 cycloidal\_propeller:** the descriptor which specifies that the rotating machinery is a cycloidal propeller.

**4.2.167.2 gas\_turbine:** the descriptor which specifies that the rotating machinery is a gas turbine.

**4.2.167.3 screw\_propeller:** the descriptor which specifies that the rotating machinery is a screw propeller.

**4.2.167.4 steam\_turbine:** the descriptor which specifies that the rotating machinery is a steam turbine.

**4.2.167.5 supercharger:** the descriptor which specifies that the rotating machinery is a supercharger.

**4.2.167.6 turbocharger:** the descriptor which specifies that the rotating machinery is a turbocharger.

**4.2.167.7 user\_defined\_rotating\_machinery\_type:** the descriptor, set by the user, which specifies the type of rotating machinery if different from the other options.

## **4.2.168 Rotational\_speed**

A Rotational\_speed is a type of Measure\_with\_unit (4.2.104) where the physical quantity is rotational speed.

The data associated with a Rotational\_speed are the following:

- rotational\_speed\_unit.

The rotational\_speed\_unit attribute specifies all the units for the rotational speed.

## **4.2.169 Screw\_propeller**

A Screw\_propeller is a type of Rotating\_machinery (see 4.2.167) and specifies the data representation concept for all the screw propellers which need to be defined.

The data associated with a Screw\_propeller are the following:

- propeller\_type.

The propeller\_type attribute specifies the general type of propeller in text format.

## **4.2.170 Screw\_propeller\_composition**

A `Screw_propeller_composition` is a type of `Mechanical_machinery_composition` (see 4.2.109) and specifies the concept for collection of all the product composition (see 3.8.26) data which are attributable to all types of screw propellers.

The data associated with a `Screw_propeller_composition` are the following:

- `defined_for`;
- `number_of_blades`.

#### **4.2.170.1    `defined_for`**

The `defined_for` attribute specifies a set of one to many screw propellers for which composition data are defined.

#### **4.2.170.2    `number_of_blades`**

The `number_of_blades` attribute specifies the number of blades for the propeller. The `number_of_blades` is a DERIVED parameter from higher level product structure definitions.

### **4.2.171    `Screw_propeller_design_characteristic`**

A `Screw_propeller_design_characteristic` is a type of `Machinery_design_characteristic` (see 4.2.90) and specifies the concept for collection of all the product design characteristics which are attributable to all types of screw propellers.

The data associated with a `Screw_propeller_design_characteristic` are the following:

- `defined_for`;
- `design_points`;
- `max_ahead_pitch`;
- `max_astern_pitch`.

#### **4.2.171.1    `defined_for`**

The `defined_for` attribute specifies a set of one to many screw propellers for which design characteristics are defined.

#### **4.2.171.2    `design_points`**

The `design_points` attribute specifies a set of design operating points by referencing a `Power_speed_pitch_point` (see 4.2.143) application object.

#### **4.2.171.3    `max_ahead_pitch`**

The `max_ahead_pitch` specifies the maximum pitch value for the ship ahead motion.

#### **4.2.171.4    `max_astern_pitch`**

The `max_astern_pitch` specifies the maximum pitch value for the ship astern motion.

## 4.2.172 Screw\_propeller\_general\_characteristic

A `Screw_propeller_general_characteristic` is a type of `MP_equipment_general_characteristic` (see 4.2.123) and specifies the data representation concept for all the general characteristics (see 3.8.77) which are attributable to all types of screw propellers.

The data associated with a `Screw_propeller_general_characteristic` are the following:

- `defined_for`;
- `fit_of_hub_to_shaft`;
- `hub_type`;
- `pitch_control_mechanism_description`;
- `propeller_type_by_blade_outline`.
- `propeller_type_by_design_configuration`;
- `propeller_type_by_duct`;
- `propeller_type_by_pitch`;
- `type_of_construction`.

### 4.2.172.1 defined\_for

The `defined_for` attribute specifies a set of one to many screw propellers for which the general characteristics are defined.

### 4.2.172.2 fit\_of\_hub\_to\_shaft

The `fit_of_hub_to_shaft` attribute specifies the information on the fit of hub to shaft in text format.

### 4.2.172.3 hub\_type

The `hub_type` attribute specifies the type of hub in text format.

### 4.2.172.4 pitch\_control\_mechanism\_description

The `pitch_control_mechanism_description` attribute specifies a description of the pitch control mechanism details, in text format.

### 4.2.172.5 propeller\_type\_by\_blade\_outline

The `propeller_type_by_blade_outline` attribute specifies the type of blade outline.

The value of `propeller_type_by_blade_outline` shall be one of the following:

- `conventional`;
- `skewed`;
- `user_defined_blade_outline_type`.



**4.2.172.5.1 conventional:** the descriptor which specifies the propeller blade outline to be of type conventional.

**4.2.172.5.2 skewed:** the descriptor which specifies the propeller blade outline to be of type skewed.

**4.2.172.5.3 user\_defined\_blade\_outline\_type:** the descriptor, set by the user, which specifies the outline type of propeller blade if different from the other options.

## **4.2.172.6 propeller\_type\_by\_design\_configuration**

The `propeller_type_by_design_configuration` specifies the type of propeller according to design configuration.

The value of `propeller_type_by_design_configuration` shall be one of the following:

- `contra_rotating`;
- `conventional`;
- `user_defined`;
- `vane_wheel`.

**4.2.172.6.1 contra\_rotating:** the descriptor which specifies the type of propeller design configuration as contra-rotating.

**4.2.172.6.2 conventional:** the descriptor which specifies the type of propeller design configuration as conventional.

**4.2.172.6.3 user\_defined:** the descriptor, set by the user, which specifies the type of propeller design configuration if different from the other options.

**4.2.172.6.4 vane\_wheel:** the descriptor which specifies the type of propeller design configuration as vane-wheel.

## **4.2.172.7 propeller\_type\_by\_duct**

The `propeller_type_by_duct` attribute specifies whether a propeller is of type ducted or non-ducted.

The value of `propeller_type_by_duct` shall be one of the following:

- `ducted_fixed`;
- `ducted_steerable`;
- `non_ducted`.

**4.2.172.7.1 ducted\_fixed:** the descriptor which specifies that the propeller is ducted. The duct is fixed in this case.

**4.2.172.7.2 ducted\_steerable:** the descriptor which specifies that the propeller is ducted. The duct is steerable in this case.

**4.2.172.7.3 non\_ducted:** the descriptor which specifies that the propeller is non-ducted.

## **4.2.172.8 propeller\_type\_by\_pitch**

The `propeller_type_by_pitch` attribute specifies the type of propeller by its pitch.

The value of `propeller_type_by_pitch` shall be one of the following:

- `adjustable_pitch`;
- `controllable_pitch`;
- `fixed_pitch`.

**4.2.172.8.1 adjustable\_pitch:** the descriptor which specifies that the propeller pitch can be adjusted manually at a dry dock.

**4.2.172.8.2 controllable\_pitch:** the descriptor which specifies that the propeller pitch can be controlled automatically.

**4.2.172.8.3 fixed\_pitch:** the descriptor which specifies that the propeller pitch is fixed.

## **4.2.172.9 type\_of\_construction**

The `type_of_construction` attribute specifies the type of construction of a screw propeller.

The value of `type_of_construction` shall be one of the following:

- `built_up`;
- `monoblock`;
- `user_defined_type_of_construction`.

**4.2.172.9.1 built\_up:** the descriptor which specifies the method of construction to be of type built-up.

**4.2.172.9.2 monoblock:** the descriptor which specifies the method of construction to be of type monoblock.

**4.2.172.9.3 user\_defined\_type\_of\_construction:** the descriptor, set by the user, which specifies the type of construction if different from the other options.

## **4.2.173 Screw\_propeller\_mass\_weight\_inertia**

A `Screw_propeller_mass_weight_inertia` is a type of `Mass_weight_inertia` (see 4.2.102) and specifies the mass related data for a screw propeller.

The data associated with a `Screw_propeller_mass_weight_inertia` are the following:

- defined\_for;
- entrained\_water\_method\_of\_calculation;
- inertia\_in\_water;
- weight\_including\_water.

#### **4.2.173.1 defined\_for**

The defined\_for attribute specifies a set of one to many screw propellers for which mass-related data are defined.

#### **4.2.173.2 entrained\_water\_method\_of\_calculation**

The entrained\_water\_method\_of\_calculation attribute specifies the calculation method of entrained water in the text format.

#### **4.2.173.3 inertia\_in\_water**

The inertia\_in\_water attribute specifies the propeller mass moment of inertia when in water (including entrained water).

#### **4.2.173.4 weight\_including\_water**

The weight\_including\_water attribute specifies the weight of the propeller inclusive of entrained water.

### **4.2.174 Screw\_propeller\_operational\_characteristic**

A Screw\_propeller\_operational\_characteristic is a type of Machinery\_operational\_characteristic (see 4.2.92) and specifies the concept for collecting all the operational characteristics which are attributable to all types of screw propellers.

The data associated with a Screw\_propeller\_operational\_characteristic are the following:

- defined\_for;
- immersion\_in\_ballast\_condition;
- immersion\_in\_loaded\_condition;
- operating\_points.

#### **4.2.174.1 defined\_for**

The defined\_for attribute specifies a set of one to many screw propellers for which operational characteristics are defined.

#### **4.2.174.2 immersion\_in\_ballast\_condition**

The immersion\_in\_ballast\_condition attribute specifies the depth of propeller immersion when the ship is under ballast condition.

### 4.2.174.3 immersion\_in\_loaded\_condition

The immersion\_in\_loaded\_condition attribute specifies the depth of propeller immersion when the ship is under loaded condition.

### 4.2.174.4 operating\_points

The operating\_points attribute specifies a set of operating points through reference to Power\_speed\_pitch\_point (see 4.2.143) application object.

## 4.2.175 Screw\_propeller\_overall\_dimension

The Screw\_propeller\_overall\_dimension is a type of Overall\_dimension (see 4.2.132) and specifies the data representation concept for collecting all the overall dimensions which are attributable to all types of screw propellers.

The data associated with a Screw\_propeller\_overall\_dimension are the following:

- blade\_area\_ratio\_expanded;
- blade\_thickness\_at\_centreline;
- defined\_for;
- diameter;
- hub\_to\_diameter\_ratio;
- mean\_pitch\_diameter\_ratio;
- nominal\_design\_pitch\_diameter\_ratio;
- rake\_angle;
- shaft\_height;
- skew\_angle;
- tip\_clearance\_to\_hull.

### 4.2.175.1 blade\_area\_ratio\_expanded

The blade\_area\_ratio\_expanded attribute specifies the ratio of the total area of the blades to the propeller projected area.

### 4.2.175.2 blade\_thickness\_at\_centreline

The blade\_thickness\_at\_centreline attribute specifies the thickness of the propeller blade at its centreline.

### 4.2.175.3 defined\_for

The defined\_for attribute specifies a set of one to many screw propellers for which overall dimensions are defined.

### 4.2.175.4 diameter

The diameter specifies the propeller diameter.

#### **4.2.175.5 hub\_to\_diameter\_ratio**

The hub\_to\_diameter\_ratio attribute specifies the ratio of the hub diameter to propeller diameter.

#### **4.2.175.6 mean\_pitch\_diameter\_ratio**

The mean\_pitch\_diameter\_ratio specifies the ratio of propeller mean pitch to propeller diameter.

#### **4.2.175.7 nominal\_design\_pitch\_diameter\_ratio**

The nominal\_design\_pitch\_diameter\_ratio attribute specifies the ratio of the nominal mean design pitch to propeller diameter.

#### **4.2.175.8 rake\_angle**

The rake\_angle attribute specifies the propeller rake angle.

#### **4.2.175.9 shaft\_height**

The shaft\_height attribute specifies the distance between propeller shaft centre and ship baseline.

#### **4.2.175.10 skew\_angle**

The skew\_angle attribute specifies the propeller skew angle.

#### **4.2.175.11 tip\_clearance\_to\_hull**

The tip\_clearance\_to\_hull attribute specifies the clearance length (minimum distance) between propeller tip and hull.

### **4.2.176 Shaft**

A Shaft is a type of Rotating\_component (see 4.2.166) which specifies the high level concept for all the shafts (see 3.8.139) which need to be defined.

The data associated with a Shaft are the following:

- shaft\_type.

The shaft\_type attribute specifies the type of shaft.

### **4.2.177 Ship**

A Ship is a type of Item (see 4.2.74) that specifies the ship concerned. All data defining the product are somehow to be related to a ship, which might exist in any life cycle stage.

The data associated with a Ship are the following:

- placements;
- units.

#### **4.2.177.1 placements**

The placements attribute specifies the redefine of the inherited attribute placement.

#### **4.2.177.2 units**

The units attribute specifies a reference to a set of pre-defined unit for all measures that may appear in the ship model. There may be more than one units for a Ship.

### **4.2.178 Ship\_space**

A Ship\_space specifies the ship spaces/locations, within which the mechanical product may be or is positioned.

The data associated with a Ship\_space are the following:

- ship\_space\_name.

The ship\_space\_name attribute specifies the name of the ship space.

The value of the ship\_space\_name shall be one of the following:

- engine\_room;
- deck;
- machinery\_room;
- user\_defined\_ship\_space.

**4.2.178.1 engine\_room:** The descriptor which specifies that the mechanical product is placed in the engine room.

**4.2.178.2 deck:** The descriptor which specifies that the mechanical product is placed on the deck.

**4.2.178.3 machinery room:** The descriptor which specifies that the mechanical product is placed in the machinery room.

**4.2.178.4 user\_defined\_ship\_space:** The descriptor, set by the user, which specifies the ship compartment within which the mechanical product is located if different from the other options.

### **4.2.179 Solid\_material\_property**

A Solid\_material\_property is a type of Material\_property (see 4.2.103) and specifies the high level concept for all the properties which are attributable to a solid material.

The data associated with a Solid\_material\_property are the following:

- corrosion\_fatigue\_strength;
- defined\_for;
- density;
- element\_contents;
- elongation;
- fatigue\_strength;
- hardness\_number;
- poisson\_ratio;
- shear\_modulus;
- stress\_of\_fracture;
- thermal\_expansion\_ratio;
- ultimate\_tensile\_stress;
- yield\_point;
- youngs\_modulus.

#### **4.2.179.1 corrosion\_fatigue\_strength**

The corrosion\_fatigue\_strength attribute specifies the material fatigue strength under corrosion conditions.

#### **4.2.179.2 defined\_for**

The defined\_for attribute specifies a solid material for which the properties are defined.

#### **4.2.179.3 density**

The density attribute specifies the density of the material.

#### **4.2.179.4 element\_contents**

The element\_contents attribute specifies details of compositional elements of a solid material by referencing an Element\_content (see 4.2.47) application object.

#### **4.2.179.5 elongation**

The elongation attribute specifies the stretching characteristic of a solid material under tensile stress.

#### **4.2.179.6 fatigue\_strength**

The fatigue\_strength attribute specifies the fatigue strength of a material which is the highest stress that a material can be expected to withstand for an infinite number of cycles without failure.

#### **4.2.179.7 hardness\_number**

The hardness\_number attribute specifies a number indicating the relative hardness of a substance as determined by various hardness tests.

**4.2.179.8 poisson\_ratio**

The poisson\_ratio attribute specifies the poisson ratio of the material which is the negative ratio between longitudinal and transversal strains.

**4.2.179.9 shear\_modulus**

The shear\_modulus attribute specifies the material shear modulus which indicates the strength factor for the material under shear stress. The shear\_modulus is a DERIVED attribute from youngs\_modulus and poisson\_ratio.

**4.2.179.10 stress\_of\_fracture**

The stress\_of\_fracture attribute specifies the stress level beyond which the material will undergo fraction and loose coherence.

**4.2.179.11 thermal\_expansion\_ratio**

The thermal\_expansion\_ratio attribute specifies the linear expansion caused by a unit change of material temperature level.

**4.2.179.12 ultimate\_tensile\_stress**

The ultimate\_tensile\_stress attribute specifies the material's ultimate tensile stress which is the highest tensile stress that a material can withstand before it fractures or fails.

**4.2.179.13 yield\_point**

The yield\_point attribute specifies the yield point of the material. The yield point defines the limit to elastic deformation beyond which the material undergoes plastic deformation.

**4.2.179.14 youngs\_modulus**

The youngs\_modulus attribute specifies the material youngs modulus of elasticity which is the ratio between stress and strain in the elastic region (Hook's law).

**4.2.180 Solid\_model**

A Solid\_model is a complete representation of the nominal shape of a product such that all points in the interior are connected. Any point can be classified as being inside, outside or on the boundary of a solid. It is used as defined in ISO 10303-41.

**4.2.181 Spare\_part**

A Spare\_part is a type of Task\_resource (see 4.2.197) which specifies the concept for collecting information on spare parts needed for a task.

The data associated with a Spare\_part are the following:



- spare\_parts\_list.

The spare\_parts\_list attribute provides a list of all the required spare parts.

#### **4.2.182 Speed**

A Speed is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is linear speed.

The data associated with a Speed are the following:

- speed\_unit.

The speed\_unit attribute specifies all the units in which linear speed is measured.

#### **4.2.183 Steam\_generation\_system**

A Steam\_generation\_system is a type of Mechanical\_system (see 4.2.119) which specifies the high level concept for all the ship's steam generation systems which need to be defined.

The data associated with a Steam\_generation\_system are the following:

- type\_of.

The type\_of attribute specifies the basic types of steam generation systems.

#### **4.2.184 Stress**

A Stress is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is the stress within a material.

The data associated with a Stress are the following:

- stress\_unit.

The stress\_unit attribute specifies all the units in which the physical quantity of stress is measured.

#### **4.2.185 Structural\_connection**

A Structural\_connection is a type of Mechanical\_product\_connection (see 4.2.113) which specifies the connection (see 3.8.34) between a mechanical product and a ship structure.

The data associated with a Structural\_connection are the following:

- connection\_type.

A connection\_type attribute specifies the type of the structural connection.

The value of a connection\_type shall be one of the following:

- component\_mounting;
- equipment\_mounting;

- equipment\_support;
- insulation\_attachment;
- pipe\_support;
- user\_defined\_structural\_connection.

**4.2.185.1 component\_mounting:** the descriptor which specifies that the structural connection is of type component mounting.

**4.2.185.2 equipment\_mounting:** the descriptor which specifies that the structural connection is of type equipment mounting.

**4.2.185.3 equipment\_support:** the descriptor which specifies that the structural connection is of type equipment support.

**4.2.185.4 insulation\_attachment:** the descriptor which specifies that the structural connection is of type insulation attachment.

**4.2.185.5 pipe\_support:** the descriptor which specifies that the structural connection is of type pipe support.

**4.2.185.6 user\_defined\_structural\_connection:** the descriptor, set by the user, which specifies the type of structural connection if different from the other options.

## **4.2.186 Structural\_connector**

A Structural\_connector is a type of Connector\_component (see 4.2.16) and specifies the high level concept for data representation of all types of structural connectors (see 3.8.35) which need to be defined.

The data associated with a Structural\_connector are the following:

- structural\_connector\_type.

The structural\_connector\_type attribute specifies the type of the structural connector in text format.

## **4.2.187 Surface\_tension**

A Surface\_tension is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is surface tension of a liquid.

The data associated with a Surface\_tension are the following:

- surface\_tension\_unit.

The surface\_tension\_unit attribute specifies all the units in which the physical quantity of force per length is measured.

## **4.2.188 Survey\_inspection\_task**

A `Survey_inspection_task` is a type of `Task` (see 4.2.189) and specifies the concept for collecting data which are attributable to a survey/inspection task.

The data associated with a `Survey_inspection_task` are the following:

- `type_of_task`.

The `type_of_task` attribute specifies the type of survey/inspection task in a text format.

## **4.2.189 Task**

A `Task` specifies the high level concept for data representation for all various tasks (see 3.8.155) and activities (3.8.2) which need to be defined.

The data associated with a `Task` are the following:

- `description`;
- `job_number`;
- `reason_for_task`;
- `related_mechanical_products`;
- `related_tasks`;
- `standard_definition`;
- `task_status`;
- `task_type`.

### **4.2.189.1 description**

The `description` attribute specifies a textual description of the task.

### **4.2.189.2 job\_number**

The `job_number` specifies a unique label for identification of the task.

### **4.2.189.3 reason\_for\_task**

The `reason_for_task` attribute specifies the overall objective of the task.

### **4.2.189.4 related\_mechanical\_products**

The `related_machanical_products` attribute specifies the mechanical products which are related to the task.

### **4.2.189.5 related\_tasks**

The `related_tasks` attribute specifies the tasks which are related to this task.

#### 4.2.189.6 standard\_definition

The standard\_definition attribute specifies a textual standard definition for the task. The standard definition shall be according to this part of ISO 10303.

#### 4.2.189.7 task\_status

The task\_status attribute specifies the status of a task within its life cycle.

The value of task\_status shall be one of the following:

- completed;
- concept;
- executed;
- planned;
- under\_execution;
- under\_planning.

**4.2.189.7.1 completed:** the descriptor which specifies that the task has been fully completed without any need for further action.

**4.2.189.7.2 concept:** the descriptor which specifies that the task is at the concept stage.

**4.2.189.7.3 executed:** the descriptor which specifies that the task has been executed.

**4.2.189.7.4 planned:** the descriptor which specifies that the task planning is complete but not executed.

**4.2.189.7.5 under\_execution:** the descriptor which specifies that the task is at the execution stage.

**4.2.189.7.6 under\_planning:** the descriptor which specifies that the task is at the planning stage.

#### 4.2.189.8 task\_type

The task\_type attribute specifies the type of task at high level.

The value of the task\_type shall be one of the following:

- analysis\_task;
- design\_task;
- inspection\_task;
- maintenance\_task;
- normal\_operation\_task;
- survey\_task;
- user\_defined\_task.

**4.2.189.8.1 analysis\_task:** the descriptor which specifies that the task is an analysis task.

**4.2.189.8.2 design\_task:** the descriptor which specifies that the task is a design task.

**4.2.189.8.3 inspection\_task:** the descriptor which specifies that the task is an inspection task.

**4.2.189.8.4 maintenance\_task:** the descriptor which specifies that the task is a maintenance task.

**4.2.189.8.5 normal\_operation\_task:** the descriptor which specifies that the task is a normal operation task.

**4.2.189.8.6 survey\_task:** the descriptor which specifies that the task is a survey task.

**4.2.189.8.7 user\_defined\_task:** the descriptor, set by the user, which specifies the type of task if different from the other options.

## **4.2.189.9 related\_mechanical\_products**

The related\_mechanical\_products attribute specifies the mechanical products which this task relates to. Each task must have at least one related mechanical product.

## **4.2.190 Task\_approval**

A Task\_approval is a type of Approval\_event (see 4.2.6) and specifies task-related data on approval and authorisation.

## **4.2.191 Task\_configuration**

A Task\_configuration is a type of Task\_definition (see 4.2.192) and specifies all the data relating to the configuration (see 3.8.32) of a task (see 3.8.155)

The data associated with a Task\_configuration are the following:

- task\_approval;
- task\_authorisation;
- task\_location.

### **4.2.191.1 task\_approval**

The task\_approval specifies information on approval of a task in the form of event and approval data (see 3.8.60).

### **4.2.191.2 task\_authorisation**

The task\_authorisation specifies information on authorisation of a task in the form of event and approval data (see 3.8.60).

### 4.2.191.3 task\_location

The task\_location attribute specifies the place where the task is performed.

The value of task\_location shall be one of the following:

- in\_shipyard;
- in\_supplier\_premises;
- on\_board\_ship;
- user\_defined\_location.

**4.2.191.3.1 in\_shipyard:** the descriptor which specifies that the task is to be performed at a shipyard.

**4.2.191.3.2 in\_supplier\_premises:** the descriptor which specifies that the task is to be performed at the supplier's premises.

**4.2.191.3.3 on\_board\_ship:** the descriptor which specifies that the task is to be performed on board ship.

**4.2.191.3.4 user\_defined\_location:** the descriptor, set by the user, which specifies the location where the task will be executed if different from the other options.

## 4.2.192 Task\_definition

A Task\_definition is the supertype for all kinds of task-related definitions and specifies the high level concept for relating definitions to a task.

The data associated with a Task\_definition are the following:

- defined\_for;
- version\_id.

### 4.2.192.1 defined\_for

The defined\_for attribute specifies the tasks for which definitions are provided. There may be more than one defined\_for for a Task\_definition.

### 4.2.192.2 version\_id

The version\_id attribute specifies a simple versioning mechanism for the task definitions.

## 4.2.193 Task\_other\_definition

A Task\_other\_definition is a type of Task\_definition (see 4.2.192) which specifies all task-related definitions other than those already specified in Task\_configuration (see 4.2.191), Task\_schedule (see 4.2.199), Task\_procedure (see 4.2.195), Task\_resource (see 4.2.197), Task\_result (see 4.2.198) and Task\_schedule (see 4.2.199),

The data associated with a Task\_other\_definition are the following:

- task\_other\_definitions.

The task\_other\_definitions attribute specifies all the related information in a text format.

#### **4.2.194 Task\_other\_resource**

A Task\_other\_resource is a type of Task\_resource (see 4.2.197) which specifies all resources other than those already specified in Human\_resource (see 4.2.72), Spare\_part (see 4.2.181) and Tool (see 4.2.207).

The data associated with a Task\_other\_resource are the following:

- task\_other\_resources.

The task\_other\_resources attribute specifies all the related information in a text format.

#### **4.2.195 Task\_procedure**

A Task\_procedure is a type of Task\_definition (see 4.2.192) and specifies the procedures by which a task (see 3.8.155) needs to be carried out.

The data associated with a Task\_procedure are the following:

- task\_procedures.

The task\_procedures attribute specifies and references a set of one to many documents which contain a detailed procedure for carrying out the task.

#### **4.2.196 Task\_relationship**

A Task\_relationship specifies the concept for relating two tasks together.

The data associated with a Task\_relationship are the following:

- major\_aspect\_of\_relationship;
- related\_task;
- this\_task.

##### **4.2.196.1 major\_aspect\_of\_relationship**

The major\_aspect\_of\_relationship specifies the important aspect of a task's relationship.

The value of major\_aspect\_of\_relationship shall be one of the following:

- concurrent;
- predecessor;
- successor;
- user\_defined\_relationship.

**4.2.196.1.1 concurrent:** the descriptor which specifies that `this_task` and the `related_task` should be carried out concurrently.

**4.2.196.1.2 predecessor:** the descriptor which specifies that `this_task` should be completed after the `related_task` is initiated.

**4.2.196.1.3 successor:** the descriptor which specifies that `this_task` should be carried out before the `related_task`.

**4.2.196.1.4 user\_defined\_relationship:** the descriptor, set by the user, which specifies the relationship between two tasks if different from the other options.

## **4.2.196.2 related\_task**

The `related_task` attribute specifies the task which is related to `this_task`.

## **4.2.196.3 this\_task**

The `this_task` attribute specifies a task for which a `related_task` is specified.

## **4.2.197 Task\_resource**

A `Task_resource` is a type of `Task_definition` (see 4.2.192) and specifies the high level concept for defining all the resources which are needed to perform a task.

## **4.2.198 Task\_result**

A `Task_result` is a type of `Task_definition` (see 4.2.192) and specifies the results of a task.

The data associated with a `Task_result` are the following:

- `results_as_report`;
- `results_in_summary`.

### **4.2.198.1 results\_as\_report**

The `results_as_report` attribute specifies and references a document which contains full results of a task.

### **4.2.198.2 results\_in\_summary**

The `results_in_summary` attribute specifies the summary results of a task in text format.

## **4.2.199 Task\_schedule**

A `Task_schedule` is a type of `Task_definition` (see 4.2.192) and `Time_schedule` (see 4.2.205) which specifies the schedule for a task.

## **4.2.200 Temperature**



A Temperature is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is temperature as defined in ISO 31 (clause 2).

The data associated with a Temperature are the following:

- temperature\_unit.

The temperature\_unit attribute specifies all the units in which the temperature is measured.

#### **4.2.201 Text**

A Text application object is used to assign a character text in order to describe something. It is used as defined in ISO 10303-41.

#### **4.2.202 Thermal\_conductivity**

A Thermal\_conductivity is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is thermal conductivity.

The data associated with a Thermal\_conductivity are the following:

- thermal\_conductivity\_unit.

The thermal\_conductivity\_unit attribute specifies all the units in which the physical quantity of thermal conductivity is measured.

#### **4.2.203 Time**

A Time is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is time as defined in ISO 31 (clause 2).

The data associated with a Time are the following:

- time\_unit.

The time\_unit attribute specifies all the units in which the duration of periods is measured

#### **4.2.204 Time\_period**

A Time\_period specifies a time period in terms of its start and end dates.

The data associated with a Time\_period are the following:

- duration;
- end\_date;
- start\_date.

#### 4.2.204.1 duration

The duration attribute specifies the duration of a time period. It is a DERIVED attribute.

#### 4.2.204.2 end\_date

The end\_date attribute specifies the end date for the time period.

#### 4.2.204.3 start\_date

The start\_date attribute specifies the start date for the time period.

### 4.2.205 Time\_schedule

A Time\_schedule is a type of Time\_period (see 4.2.204) and specifies a schedule on a calendar basis.

### 4.2.206 Tolerance

A Tolerance is a type of Geometric\_definition (see 4.2.67) which provide the high level concept for all the definitions attributable to geometric tolerances of a mechanical product.

The data associated with a Tolerance are the following:

- defined\_for;
- manufacturing\_tolerances.

#### 4.2.206.1 defined\_for

The defined\_for attribute specifies a set of one to many mechanical products for which tolerance data are defined.

#### 4.2.206.2 manufacturing\_tolerances

The manufacturing\_tolerances attribute specifies all the descriptive aspects of product manufacturing tolerances.

### 4.2.207 Tool

A Tool is a type of Task\_resource (see 4.2.197) which specifies the concept for collecting information on tools needed to carry out a task.

The data associated with a Tool are the following:

- tools\_list.

The tools\_list attribute specifies a list of all the required tools.

### 4.2.208 Torque

A Torque is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is Torque.

The data associated with a Torque are the following:

- torque\_unit.

The torque\_unit attribute specifies all the units for torque.

#### **4.2.209 Transformer**

A Transformer is a type of Electrical\_equipment (see 4.2.45) and specifies the data representation concept for all the transformers which need to be defined.

The data associated with a Transformer are the following:

- transformer\_type.

The transformer\_type attribute specifies the type of transformer in text format.

#### **4.2.210 Valve**

A Valve is a type of Piping\_equipment (see 4.2.139) and specifies the data representation concept for all the valves which need to be defined.

The data associated with a Valve are the following:

- valve\_type.

The valve\_type attribute specifies the type of valve.

The value of valve\_type shall be one of the following:

- ball\_valve;
- butterfly\_valve;
- check\_valve;
- diaphragm\_valve;
- gate\_valve;
- globe\_valve;
- plug\_valve;
- relief\_valve;
- solenoid\_valve;
- user\_defined\_valve\_type.

**4.2.210.1 ball\_valve:** the descriptor which specifies that the valve is of type ball valve.

**4.2.210.2 butterfly\_valve:** the descriptor which specifies that the valve is of type butterfly valve.

**4.2.210.3 check\_valve:** the descriptor which specifies that the valve is of type check valve.

**4.2.210.4 diaphragm\_valve:** the descriptor which specifies that the valve is of type diaphragm valve.

**4.2.210.5 gate\_valve:** the descriptor which specifies that the valve is of type gate valve.

**4.2.210.6 globe\_valve:** the descriptor which specifies that the valve is of type globe valve.

**4.2.210.7 plug\_valve:** the descriptor which specifies that the valve is of type plug valve.

**4.2.210.8 relief\_valve:** the descriptor which specifies that the valve is of type pressure relief valve.

**4.2.210.9 solenoid\_valve:** the descriptor which specifies that the valve is of type solenoid valve.

**4.2.210.10 user\_defined\_valve\_type:** the descriptor, set by the user, which specifies the type of valve if different from the other options.

## **4.2.211 Vector**

A Vector defines a vector in terms of the direction and the magnitude of the vector. It is used as defined in ISO 10303-42.

## **4.2.212 Viscosity**

A Viscosity is a type of Measure\_with\_unit (see 4.2.104) where the physical quantity is kinematic viscosity of the fluid.

The data associated with a Viscosity are the following:

- viscosity\_unit.

The viscosity\_unit attribute specifies all the units in which the physical quantity of area per time is measured.

### 4.3 Application Assertions

This subclause specifies the application assertions for the ship Mechanical Systems application protocol. Application assertions specify the relationships between application objects, the cardinality of relationships, and the rules required for the integrity and validity of the application objects and UoFs. The application assertions and their definitions are given below.

#### 4.3.1 Ambient\_condition to Gas

Each Ambient\_condition refers to exactly one Gas. Each Gas defines the ambient\_fluid of an Ambient\_condition.

#### 4.3.2 Ambient\_condition to Liquid

Each Ambient\_condition refers to exactly one Liquid. Each Liquid defines the ambient\_fluid of an Ambient\_condition.

#### 4.3.3 Ambient\_condition to Mechanical\_product

Each Ambient\_condition refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Ambient\_condition.

#### 4.3.4 Crane\_ambient\_condition to Crane

Each Crane\_ambient\_condition refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_ambient\_condition.

#### 4.3.5 Crane\_composition to Crane

Each Crane\_composition refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_composition.

#### 4.3.6 Crane\_design\_characteristic to Crane

Each Crane\_design\_characteristic refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_design\_characteristic.

#### 4.3.7 Crane\_general\_characteristic to Crane

Each Crane\_general\_characteristic refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_general\_characteristic.

#### 4.3.8 Crane\_load\_characteristic to Crane

Each Crane\_load\_characteristic refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_load\_characteristic.

### **4.3.9 Crane\_overall\_dimension to Crane**

Each Crane\_overall\_dimension refers to a set of one or many Cranes. A set of Cranes defines the defined\_for for Crane\_overall\_dimension.

### **4.3.10 Definition to Definable\_object**

Each Definition refers to a set of one or many Definable\_objects. A set of Definable\_objects defines the defined\_for for Definition.

### **4.3.11 Design\_characteristic to Mechanical\_product**

Each Design\_characteristic refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Design\_characteristic.

### **4.3.12 Diesel\_engine\_design\_characteristic to Diesel\_engine**

Each Diesel\_engine\_general\_characteristic refers to a set of one or many Diesel\_engines. A set of Diesel\_engines defines the defined\_for for Diesel\_engine\_design\_characteristic.

### **4.3.13 Diesel\_engine\_general\_characteristic to Diesel\_engine**

Each Diesel\_engine\_general\_characteristic refers to a set of one or many Diesel\_engines. A set of Diesel\_engines defines the defined\_for for Diesel\_engine\_general\_characteristic.

### **4.3.14 Diesel\_engine\_operational\_characteristic to Diesel\_engine**

Each Diesel\_engine\_operational\_characteristic refers to a set of one or many Diesel\_engines. A set of Diesel\_engines defines the defined\_for for Diesel\_engine\_operational\_characteristic .

### **4.3.15 Failure to Fault**

Each Failure refers to a set of one or many Faults. A set of Faults defines the defined\_for for Failure.

### **4.3.16 Gas\_material\_property to Gas**

Each Gas\_material\_property refers to a set of one or many Gases. A set of Gases defines the defined\_for for Gas\_material\_property.

### **4.3.17 Lifting\_equipment\_design\_characteristic to Lifting\_equipment**

Each Lifting\_equipment\_design\_characteristic refers to a set of one or many Lifting\_equipment. A set of Lifting\_equipment defines the defined\_for for Lifting\_equipment\_design\_characteristic.

### **4.3.18 Liquid\_material\_property to Liquid**

Each Liquid\_material\_property refers to a set of one or many Liquids. A set of Liquids defines the defined\_for for Liquid\_material\_property.

#### **4.3.19 Machinery\_ambient\_condition to Machinery**

Each Machinery\_ambient\_condition refers to a set of one or many Machinery. A set of Machinery defines the defined\_for for Machinery\_ambient\_condition.

#### **4.3.20 Machinery\_general\_characteristic to Machinery**

Each Machinery\_general\_characteristic refers to a set of one or many Machinery. A set of Machinery defines the defined\_for for Machinery\_general\_characteristic.

#### **4.3.21 Machinery\_operational\_characteristic to Machinery**

Each Machinery\_operational\_characteristic refers to a set of one or many Machinery. A set of Machinery defines the defined\_for for Machinery\_operational\_characteristic.

#### **4.3.22 Maintenance\_configuration\_data to Maintenance\_task**

Each Maintenance\_configuration\_data refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_configuration\_data.

#### **4.3.23 Maintenance\_procedure to Maintenance\_task**

Each Maintenance\_procedure refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_procedure.

#### **4.3.24 Maintenance\_result to Maintenance\_task**

Each Maintenance\_result refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_result.

#### **4.3.25 Maintenance\_schedule to Maintenance\_task**

Each Maintenance\_schedule refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_schedule.

#### **4.3.26 Maintenance\_spare\_part to Maintenance\_task**

Each Maintenance\_spare\_part refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_spare\_part.

#### **4.3.27 Maintenance\_tool to Maintenance\_task**

Each Maintenance\_tool refers to a set of one or many Maintenance\_tasks. A set of Maintenance\_tasks defines the defined\_for for Maintenance\_tool.

#### **4.3.28 Mass\_weight\_inertia to Mechanical\_product**

Each Mass\_weight\_inertia refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Mass\_weight\_inertia .

#### **4.3.29 Mechanical\_machinery\_composition to Mechanical\_machinery**

Each Mechanical\_machinery\_composition refers to a set of one or many Mechanical\_machinery. A set of Mechanical\_machinery defines the defined\_for for Mechanical\_machinery\_composition.

#### **4.3.30 Mechanical\_machinery\_identification to Mechanical\_machinery**

Each Mechanical\_machinery\_identification refers to a set of one or many Mechanical\_machinery. A set of Mechanical\_machinery defines the defined\_for for Mechanical\_machinery\_identification.

#### **4.3.31 Mechanical\_product\_drawing to Mechanical\_product**

Each Mechanical\_product\_drawing refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Mechanical\_product\_drawing.

#### **4.3.32 Mechanical\_product\_general\_characteristic to Mechanical\_product**

Each Mechanical\_product\_general\_characteristic refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Mechanical\_product\_general\_characteristic.

#### **4.3.33 MP\_equipment\_identification to MP\_equipment**

Each MP\_equipment\_identification refers to a set of one or many MP\_equipment. A set of MP\_equipment defines the defined\_for for MP\_equipment\_identification .

#### **4.3.34 Overall\_dimension to Mechanical\_product**

Each Overall\_dimension refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Overall\_dimension.

#### **4.3.35 Product\_assembly to Mechanical\_product**

Each Product\_assembly refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_assembly.

#### **4.3.36 Product\_composition to Mechanical\_product**

Each Product\_composition refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_composition .

#### **4.3.37 Product\_connectivity to Mechanical\_product**

Each Product\_connectivity refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_connectivity.

#### **4.3.38 Product\_context to Mechanical\_product**



Each Product\_context refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_context.

#### **4.3.39 Product\_material to Mechanical\_product**

Each Product\_material refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_material .

#### **4.3.40 Product\_participation to Mechanical\_product**

Each Product\_participation refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_participation .

#### **4.3.41 Product\_placement to Mechanical\_product**

Each Product\_placement refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_placement .

#### **4.3.42 Product\_status to Mechanical\_product**

Each Product\_status refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Product\_status.

#### **4.3.43 Tolerance to Mechanical\_product**

Each Tolerance refers to a set of one or many Mechanical\_products. A set of Mechanical\_products defines the defined\_for for Tolerance.

*The remainder of the application assertions will be defined at a later date.*

## 5 Application interpreted model

### 5.1 Mapping Table

This clause contains the mapping table that shows how each UoF and application object of this part of ISO 10303 (see clause 4) maps to one or more AIM constructs (see Annex A).

*To be completed at a later date.*

### 5.2 AIM EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources and the AICs and contains types, entity specialisations, rules and functions that are specific to this part of ISO 10303. This clause also specifies modification to the textual material for constructs that are imported from the integrated resources and the AICs. The definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. Requirements stated in the integrated resources which refer to such items and subtypes apply exclusively to those items which are imported into the AIM.

*To be completed at a later date.*

## 6. Conformance requirements

Conformance to this part of ISO 10303 includes satisfying the requirements stated in this part, the requirements of the implementation methods supported, and the relevant requirements of the normative references.

An implementation shall support at least one of the following implementation methods:

- ISO 10303-21
- ISO 10303-22

Requirements with respect to implementation methods are specified in annex C.

The Protocol Information Conformance Statement (PICS) proforma lists the options or the combinations of options that may be included in the implementation. The PICS proforma is provided in annex D.

NOTE 1 - ISO 10303-326: - <sup>1)</sup> defines the abstract test suite to be used in the assessment of conformance.

ISO 10303-32: - <sup>1)</sup> describes the conformance assessment process.

Conformance to a particular class requires that all AIM elements defined as part of that class be supported. Table (*to be specified later*) defines the classes to which each AIM element belongs. The conformance classes are characterised as follows:

This part of ISO 10303 specifies a number of conformance classes that may be supported by an implementation. The conformance classes are:

- Class 1, the shape representation of the mechanical systems and their principal equipment together with their product structure and connectivity information. This class excludes all the functional and design characteristics of the systems/equipment.
- Class 2, the general characteristics and specifications of the mechanical systems and their principal equipments.
- Class 3, functional design of mechanical systems primarily in the form of parametric definitions. This class contains only functional information, but no detailed geometric and other physical and spatial details.
- Class 4, operational characteristics of mechanical equipment. This class contains only operational information (as normally measured on-board ship), but no geometric, physical, spatial and design characteristics details.
- Class 5, task and activity information as carried out in relation to mechanical equipments. This class excludes any functional, physical, spatial or design information and will include information on activities carried out in relation to mechanical products.

Table 1 defines the division of conformance classes and the related units of functionality within a conformance class

Table 1 - Conformance Classes

Unit of functionality	Conformance Class				
	1	2	3	4	5
configuration_definitions	X	X	X	X	X
cranes	X	X	X	X	X
diesel_engines	X	X	X	X	X
external_references	X	X	X	X	X
gas_material_properties			X	X	
lifting equipments	X	X	X	X	X
liquid_material_properties			X	X	
local_co_ordinate_systems	X				
machineries	X	X	X	X	X
maintenance_tasks					X
measure_with_units	X	X	X	X	X
mechanical_machineries	X	X	X	X	X
mechanical_product_anomalies				X	X
mechanical_product_components	X			X	X
mechanical_product_connections	X	X			
mechanical_product_definitions	X	X	X	X	X
mechanical_product equipments	X	X	X	X	X
mechanical_product_general_characteristics	X	X	X	X	X
mechanical_product_representations	X				
mechanical_product_structures	X			X	X
mechanical_product_systems	X	X	X	X	X
mechanical_products	X	X	X	X	X
other equipments	X	X	X	X	X
other_tasks					X
part41_resources	X	X	X	X	X
part42_resources	X	X	X	X	X
RAM_characteristics				X	X
reciprocating_machineries	X	X	X	X	X
screw_propellers	X	X	X	X	X
ships	X	X	X	X	X
solid-material_properties		X	X	X	X
task_definitions					X
tasks					X
time_and_events	X	X	X	X	X

**Annex A**  
(normative)

**AIM EXPRESS expanded listing**

The following EXPRESS is the expanded form of the short form schema given in 5.2. In the event of any discrepancy between the short form and this expanded listing, the expanded listing shall be used.

*To be completed at a later date*

**Annex B**  
(normative)

**AIM short names**

Table B.1 provides the short names of entities specified in the AIM of this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

**Table B.1 - Short names of entities**

Entity names	Short names

*To be completed at a later date.*

## **Annex C**

(normative)

### **Implementation method - specific requirements**

The implementation method defines what types of exchange behaviour are required with respect to this part of ISO 10303. Conformance to this part of ISO 10303 shall be realised in an exchange structure. The file format shall be encoded according to the syntax and EXPRESS language mapping defined in ISO 10303-21 and the AIM defined in annex A of this part of ISO 10303. The header of the exchange structure shall identify the use of this part of ISO 10303 by the schema name 'ship\_mechanical\_systems'.

*To be completed at a later date*

## Annex D (normative)

### Protocol Implementation Conformance Statement (PICS) proforma

The PICS proforma is supplied for completion by the person or organisation (the client) requesting conformance testing. Its purpose is to ascertain the scope of claimed conformance to a particular application protocol by an implementation under test (IUT) using a defined implementation method. Through the completion of this form, the PICS Proforma becomes a PICS.

The information contained in the PICS is used to configure an appropriate executable test suite for use by the client.

Ten conformance classes are identified in this part of ISO 10303. A conforming implementation shall support at least one conformance class. Each class specifies a subset of ISO 10303-226 AIM constructs. These classes are detailed in clause 6 of ISO 10303-226.

#### Questions:

1. Please provide an identifier for the product or system for which conformance is claimed:

Product name and current version number: \_\_\_\_\_

2. Please indicate the implementation method chosen:

- ISO 10303-21 Exchange Structure - - preprocessor

Preprocessor name and current version number: \_\_\_\_\_

- ISO 10303-21 Exchange Structure - - postprocessor

Postprocessor name and current version number: \_\_\_\_\_

3. Please indicate the classes for which conformance is claimed:

- Class 1: \_\_\_\_\_

- Class 2: \_\_\_\_\_

- Class 3: \_\_\_\_\_

*To be completed at a later date*



## **Annex E**

(normative)

### **Information object registration**

#### **E.1 Document identification**

In order to provide for unambiguous identification of an information object in an open system, the object identifier:

{ iso standard 10303 part(226) version(-1) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

#### **E.2 Schema identification**

In order to provide for unambiguous identification of the schema specifications given in this application protocol in an open information system, object identifiers are assigned as follows:

*To be completed at a later date*

## Annex F (informative)

### Application activity model

The application activity model (AAM) is provided to aid the understanding of the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of the activities and the data, and a set of activity figures. The viewpoint of the AAM is the users of ship mechanical system's information, including shipbuilder, ship designer, ship operator, equipment supplier and so on.

This AAM identifies the ship life cycle activities across all shipbuilding APs with extensions to ship mechanical systems. As such, the AAM covers activities which go beyond the scope of this part of ISO 10303.

### F.1 Application activity model definitions and abbreviations

The following terms are used in the application activity model. Terms marked with an asterisk are outside the scope of this application protocol.

The definitions given in this annex do not supersede the definitions given in the main body of the text.

**F.1.1 acceptable cost level:** the acceptable cost level for maintenance task.

**F.1.2 adjust maintenance program (A4213):** the activity which leads to changes in the maintenance program.

**F.1.3 agree design (A122523):** the activity which leads to agreement by corresponding organisations on a design.

**F.1.4 agree design (A122543):** the activity which leads to agreement by corresponding organisations on a design.

**F.1.5 agree final design (A25123):** the activity which leads to agreement by corresponding organisations on a final design.

**F.1.6 agree final design (A25143):** the activity which leads to agreement by corresponding organisations on a final design.

**F.1.7 agree on auxiliary equipment detail specification (A122531):** the activity which leads to agreement by corresponding organisations on a detailed specification of the auxiliary equipment.

**F.1.8 agree on detail specification of deck machinery (A122552):** the activity which leads to agreement by corresponding organisations on a detailed specification of the deck machinery.

**F.1.9 agree on main engine detail specification (A122512):** the activity which leads to agreement by corresponding organisations on a detailed specification of the main engine.

**F.1.10 alarm:** the signal (e.g. sound or light) automatically generated in case of danger or failure.

**F.1.11 allocate material (A421414):** the activity which leads to the allocation of material (equipment, raw material etc.) to a maintenance task.

**F.1.12 allocate material (A423114):** the activity which leads to the allocation of material (equipment, raw material, etc.) to a maintenance task.

**F.1.13 allocate personnel (A421415):** the activity which leads to the allocation of personnel to a maintenance task.

**F.1.14 allocate personnel (A423116):** the activity which leads to the allocation of personnel to a maintenance task.

**F.1.15 allocate/service tools and equipment (A421416):** the activity which leads to the allocation of tools and equipment to a maintenance task.

**F.1.16 allocate/service tools and equipment (A423115):** the activity which leads to the allocation of tools and equipment to a maintenance task.

**F.1.17 allocated personnel:** the shipyard personnel, assigned and scheduled to perform a specific maintenance task.

**F.1.18 allowable limits:** the acceptable limits for typical parameters of a specific system, component or part that should be met during maintenance inspection. Otherwise corrective action is required.

**F.1.19 analyse failure (A42122):** the activity of analysing the cause of failures.

**F.1.20 approve auxiliary equipment design (A25132):** the activity which leads to the design approval, by the corresponding organisations, of auxiliary equipment.

**F.1.21 approve/certify maintenance (A42323):** the activity which leads to the approval or certification of a maintenance task.

**F.1.22 approve deck machinery design (A25152):** the activity which leads to the design approval, by the corresponding organisations, of deck machinery.

**F.1.23 approve design of ship machinery (A252):** the activity which leads to the design approval, by the corresponding organisations, of ship machinery. The design approval relates to the machinery equipment and systems. The ship certification is not complete with this activity and would need equipment manufacturing surveys, tests and installation surveys as well.

**F.1.24 approve main engine design (A25112):** the activity which leads to the approval, by corresponding organisations, of the main engine.

**F.1.25 approved design:** the design which complies to the classification society's rules and has been approved by a classification society.

**F.1.26 arrangements\*:** the arrangements of the ship are the ship's compartments and spaces. Any description of arrangements will include associated definitions of purpose for the compartment or space.

**F.1.27 assemble ship (A33):** the activity that assembles the modular units, the serviced parts and additional material that result from the production of steel sub-sections. The result is an assembled ship, that still has to be tested.

**F.1.28 assemble ship/system (A423124):** the activity of assembling a ship or its systems.

**F.1.29 assemble steel sub-sections\* (A331):** the activity of assembling the ship steel sub-sections

**F.1.30 assemble system (A421424):** the activity of assembling the ship systems.

**F.1.31 assembled ship\*:** the ship in its assembled form at the end of the construction phase. The assembled ship has to be tested and commissioned at subsequent activities.

**F.1.32 assembling information:** the data resulting from an assembly activity.

**F.1.33 authorities:** the organisations charged with ensuring the compliance to rules, regulations and standards.

**F.1.34 auxiliary equipment:** an equipment that supports one or more main systems or equipment.

**F.1.35 availability, reliability and maintainability information:** the information about the systems, equipment and components, needed for or resulting from availability, reliability and maintainability analysis.

**F.1.36 available resources:** the tools, test equipment, personnel etc. which a shipyard can allocate for maintenance purposes.

**F.1.37 base material data:** the data relating to spare parts, consumables and raw material which are available in shipyard base depots for maintenance purposes.

**F.1.38 base personnel:** the maintenance personnel at the base harbour.

**F.1.39 base tools and equipment:** tools and equipment available at the base or depot for maintenance purposes.

**F.1.40 basic hull parameters\*:** estimated principal dimensions based on historical data.

**F.1.41 bill of material\*:** the list specifying the parts and their materials which is used for ordering the required parts and material.

**F.1.42 budget\*:** the cost constraint on the design, building and maintenance of the ship.

**F.1.43 building specifications\*:** the information which specifies the detailed framework for the construction of the ship

**F.1.44 calculate cost of ship\* (A124):** this activity describes creation of documents based on technical product data and their estimated manufacturing cost. The results of this activity may contain sale price documents, financing support plan and documents describing funding and possible loans.

**F.1.45 calculate time/cost (A421413):** the activity by which the duration and cost of a maintenance action are estimated.

**F.1.46 calculate time/cost (A423113):** the activity by which the duration and cost of a maintenance action are estimated.

**F.1.47 calculated hours, schedule:** calculated required man-hours, machine-hours and schedule needed to perform a specified maintenance action.

**F.1.48 capacity:** the available resources for maintenance purposes such as the number of available personnel.

**F.1.49 carry out manoeuvring system analysis (A122542):** the activity of completing various engineering analyses on the manoeuvring system as part of design and design approval processes.

**F.1.50 carry out manoeuvring system analysis (A25142):** the activity of completing various engineering analyses on the manoeuvring system as part of design and design approval processes.

**F.1.51 carry out transmission system analysis (A122522):** the activity of completing various engineering analyses on mechanical transmission systems as part of design and design approval processes.

**F.1.52 carry out transmission system analysis (A25122):** the activity of completing various engineering analyses on mechanical transmission systems as part of design and design approval processes.

**F.1.53 certificates :** the certificates issued by the classification society and flag state on completing the ship.

**F.1.54 check boilers (A25222):** the activity of checking the boiler specifications against the rules.

**F.1.55 check deck machinery (A25225):** the activity of checking the deck machinery specifications and design against the rules.

**F.1.56 check design against rules and regulations (A2522):** the activity by class society to ensure that equipment and machinery conform to rules and regulations.

**F.1.57 check main engine (A25221):** the activity of checking the specification and design of the main engine against the rules.

**F.1.58 check manoeuvring system (A25223):** the activity of checking the specification and design of the manoeuvring system against the rules.

**F.1.59 check shafting and propeller (A25224):** the activity of checking the specification and design of main shafts and propeller against the rules.

**F.1.60 classification society:** an independent third-party organisation within the marine industry with its own rules and regulations dealing with mainly safety aspects of the ship throughout its lifecycle.

**F.1.61 collect information about local requirements for panels and elements\* (A4323):** the activity which leads to a list of requirements for panels and related elements.

**F.1.62 collect information about safety arrangements\* (A4324):** the activity which leads to the specification of data relating to safety arrangements.

**F.1.63 collect information about systems and components (A4322):** the activity which leads to the specification of information relating to systems and components of a system.

**F.1.64 collect owner's information on usage of tank\* (A4326):** the activity which leads to information relating to tank usage.

**F.1.65 collect relevant data (A42121):** the activity which leads to the collection of relevant data needed for diagnosis.

**F.1.66 collect survey information about tank to be inspected\* (A4321):** the activity which leads to the specification of tank data required prior to tank inspection.

**F.1.67 company objectives:** the business objectives of a company relating to the use of maintenance data/information for future purposes.

**F.1.68 compare values (A42112):** the activity of comparing two values for fault diagnosis purposes.

**F.1.69 complete and approve ship design (A2):** the production of ship design documents and the classification drawings using the preliminary design from the bid preparation, as well as the required rules and regulations. The classification drawing may require several iterations with input and redmarking from the classification society.

**F.1.70 complete design of outfitting and distribution systems\* (A26):** the selection of the necessary outfitting equipment. The selection is mainly based on former designs and in accordance with the requirements. It also contains the layout of the different types of distribution systems.

**F.1.71 complete design of ship machinery (A25):** the selection and arrangement of the ship equipment in terms of the main engine, associated propulsion system and its auxiliary machinery.

**F.1.72 complete design of ship structure\* (A24):** the completion of the ship structural design.

**F.1.73 components:** the equipment or components which are part of the ship systems.

**F.1.74 conclude (A42123):** the activity of concluding a diagnostic investigation.

**F.1.75 condition of class\*:** the maintenance condition of a ship from the classification society point of view. An unsatisfactory condition means that the ship no longer fulfils the classification requirements and maintenance deemed to be necessary.

**F.1.76 conduct acceptance trials\* (A344):** the activity of sea trials that are performed with the owners and classification society to test the ship against the rules and regulations and the design. The output is the test result documentation.

**F.1.77 conduct contractor sea trials\* (A343):** the activity of sea trials performed by the contractor to test the ship against rules and regulations and the design. The output is the test result documentation.

**F.1.78 contract:** the contract is the output from the activity which involves placing the order for the ship. The contract is used as a constraint in subsequent activities such as final design, approval and production.

**F.1.79 corrective actions:** the specification of activities needed to correct the status of a product.

**F.1.80 corrective maintenance plan:** the maintenance plan which specifies the corrective actions needed in order to maintain a failing system to its original specifications, fit for release for operation.

**F.1.81 cost \*:** the calculated cost of the ship based on the cost of material and labour.

**F.1.82 cost calculation data\*:** the information needed for performing a maintenance task cost analysis.

**F.1.83 create preliminary blades (A1223133):** the activity which leads to preliminary definition of propeller blades including blade overall size and geometric configuration.

**F.1.84 create preliminary design (A122):** all design activities relevant in a very preliminary stage of ship design in consideration of classification rules, national/international demands, shipyard constraints and owner requirements. The aim of this task is to make a shipyard offer.

**F.1.85 create preliminary general arrangements\* (A1222):** the activity that produces the preliminary compartmentation plans from the preliminary hull form definition.

**F.1.86 create preliminary hull form\* (A1221):** the activity that is the first step in designing a ship. Using parent ship's main dimensions and form parameters, one or more preliminary hull forms will be generated.

**F.1.87 create preliminary machinery design (A1225):** the activity that produces the preliminary designs for the ship machinery; including the prime mover, shaft system, fuel system, power systems and cargo handling equipment and so on.

**F.1.88 create preliminary outfitting design\* (A1226):** the activity that produces the preliminary design for ship's outfitting including distributed systems such as piping and electrical systems.

**F.1.89 create preliminary propeller arrangements (A1223132):** the activity which leads to the definition of the preliminary propeller arrangements in relation to hull.

**F.1.90 create preliminary propeller components (A1223134):** the activity of deciding on the preliminary structure of a propeller in terms of its major components.

**F.1.91 create preliminary structure design\* (A1224):** the activity that produces the preliminary steel structure design, including the arrangement of the primary structural members.

**F.1.92 crew:** the personnel onboard a ship.

**F.1.93 crew staff:** the ship crew members in charge of controlling and co-ordinating of shipboard activities (usually captain and officers).

**F.1.94 critical design areas:** the design areas at which a change may be expected, when performing a design approval preview

**F.1.95 data from other sources:** the data needed for performing the failure analysis which are not available from the normal on-board data sources such as logbook and maintenance manual.

**F.1.96 decide post sales maintenance and support (A123):** the activity that puts together the maintenance package for the ship. This is part of the tender document and includes the post sales support.

**F.1.97 deck machinery:** the machinery positioned on the main deck of the ship.

**F.1.98 decommission and disassembly (A5):** the activities that involve disassembly and preparing for reuse or recycling or disposal of machinery, parts, materials and so on.

**F.1.99 define corrective actions (A42131):** the activity which uses the diagnosis report and provides a list of actions needed to be undertaken as corrective maintenance.

**F.1.100 define cost\* (A42134):** the activity which leads to the estimation of maintenance cost.

**F.1.101 define resources (A42132):** the activity which leads to a list of required resources needed for maintenance.

**F.1.102 define time (A42133):** the activity which leads to specification of time needed for maintenance.

**F.1.103 deliver auxiliary equipment (A3333):** the activity which leads to the delivery of the ship equipment to the shipyard.

**F.1.104 deliver machinery (A3331):** the activity which leads to the delivery of the ship machinery to the shipyard

**F.1.105 delivery date:** the date for delivery.

**F.1.106 description of function:** the description of the function that the component to be analysed shall perform.

**F.1.107 design manoeuvring systems (A12254):** the activities which lead to design of the manoeuvring system by the shipyard for the ship.

**F.1.108 design modifications:** the list of modifications made to the original design.

**F.1.109 design transmission system (A12252):** the activities which leads to design of the ship main mechanical transmission system.

**F.1.110 detail survey planning (A4325):** the activity which leads to a detailed plan for survey.

**F.1.111 detailed instructions:** the detailed procedure, resources needed and method of carrying out a maintenance activity.

**F.1.112 detailed schedule:** the detailed timetable for execution of maintenance actions together with a schedule of availability of tools and other resources.

**F.1.113 detailed specification:** the ship equipment and systems specifications as required for approval by the ship owner.

**F.1.114 diagnose (A4212):** the activity which leads to diagnosis of the reason for a failure.

**F.1.115 diagnosis report:** a document describing the conclusion of a failure analysis. It is the basis for preparation of a corrective maintenance plan.

**F.1.116 disassemble ship/system (A423121):** the process of disassembling of a ship or its systems.

**F.1.117 disassemble system (A421421):** the activity of disassembling a ship system.

**F.1.118 distribution & outfitting design\* :** the design of the distribution systems (electrical and piping) and the outfitting.



**F.1.119 equipment:** a part of the engineering systems that carries out a generally self contained function and to a large extent can be treated as a single item for the purpose of design, acquisition or operation.

**F.1.120 estimate hydrodynamics and powering (A1223):** the activity that approximates hydrodynamic properties data calculations like resistance, propulsion, seakeeping and manoeuvrability for the preliminary hull form.

**F.1.121 estimate hydrodynamics and powering\* (A1223135):** the activity which leads to hydrodynamic resistances of a ship and the power needed for ship propulsion.

**F.1.122 estimate manoeuvrability\* (A12233):** the activity that deals with approximating the manoeuvrability of the ship and comparison of the results with design requirements. The proof of the ships manoeuvrability will principally be given in practice or by model testing. Measuring of rudder forces and rudder moments as well as of the radius of the turning circle during model tests will be done either in circulating water channels or manoeuvring basins.

**F.1.123 estimate resistance and powering (A12231):** the activity that includes the calculations based on historical data for producing powering and resistance data for the initial preliminary design.

**F.1.124 estimate sea keeping\* (A12232):** the activity that calculates the theoretical behaviour of a vessel in a seaway. The solution of the coefficients of equations of motion may be obtained either by analytical or numerical methods. The natural periods of the ship will be calculated like the rolling, pitching and heaving motions.

**F.1.125 evaluate maintenance (A4233):** the activity which leads to evaluation of the whole of the maintenance activity on behalf of either shipyard or owner.

**F.1.126 evaluate request & schedule bid\* (A121):** the activities of the shipyard when evaluating the inquiry of the ship owner for a new ship.

**F.1.127 evaluation report:** a document which contains the results of the maintenance evaluation activity and normally references the status, diagnosis, corrective action and maintenance reports.

**F.1.128 execute maintenance (A42142):** the activity which leads to execution and completion of a maintenance task.

**F.1.129 execute maintenance (A42312):** the activity which leads to execution and completion of a maintenance task.

**F.1.130 experience\*:** applied expert knowledge.

**F.1.131 failure analysis report:** a document which describes the scope, analysis methodology and result of a failure analysis activity.

**F.1.132 feedback:** the feedback information.

**F.1.133 finalise and approve general arrangements\* (A21):** the activity in which the design of a ship general arrangement is finalised as a detailed design.

**F.1.134 finalise and approve hull form\* (A22):** the activity in which the hull form is finalised from the preliminary design done in the pre-contract stages. The result is a final and approved hull form design.

**F.1.135 finalise and approve hydrodynamics and powering\* (A23):** this includes all relevant hydrodynamic calculations like resistance, propulsion, seakeeping and manoeuvrability.

**F.1.136 finalise auxiliary equipment selection (A2513):** the activity which leads to the selection and ordering of auxiliary equipment.

**F.1.137 finalise deck machinery design (A2515):** the activity which lead to the production of final design for deck machinery.

**F.1.138 finalise machinery design (A251):** the activities which leads to design of selected machinery such as the propeller which are in the scope of this part of ISO 10303.

**F.1.139 finalise main engine selection (A2511):** the activity which leads to the selection and ordering of the main engine.

**F.1.140 finalise maintenance plan (A254):** the activity which leads to preparation of a machinery maintenance plan.

**F.1.141 finalise manoeuvring system design (A2514):** the activity which leads to the design of the manoeuvring system.

**F.1.142 finalise production planning\* (A253):** the activities which lead to a production plan.

**F.1.143 finalise propeller design (A25122):** the activity which leads to the final propeller design.

**F.1.144 finalise selection of components (A25121):** the activity which leads to the selection of various ship equipment.

**F.1.145 finalise selection of components (A25141):** the activity which leads to the selection of various ship equipment.

**F.1.146 finalise transmission system design (A2512):** the activity which leads to the completion of the ship main mechanical transmission system design.

**F.1.147 general arrangements\*:** the space arrangement plan from the preliminary or final design stage.

**F.1.148 geometry, geography, technical documentation\*:** all documents, describing the ship, its systems and equipment.

**F.1.149 historical data from previous designs:** data held by the shipyard or model basin on previous ship designs and used to estimate the hydrodynamics, powering requirements and sea-keeping.

**F.1.150 hull form sections\*:** The design of the hull moulded form at planar sections taken along the longitudinal axis of the ship.

**F.1.151 hull moulded form\*:** the definition of the shape of the hull of the ship, resulting from the addition of the aft-body, mid-body and fore-body definitions, which does not take into account the thickness of the material from which the hull is made.

**F.1.152 hydrodynamics & powering results\* :** the results of calculations and model basin tests. They contain resistance, propulsion, propeller performance, brake power, service speed, sea keeping and manoeuvrability data.

**F.1.153 hydrostatic table\*:** the data which show the hydrostatic properties of the ship. They are a result of calculations at the initial and final design stages.

**F.1.154 info parts to be repaired:** the specific available information on the repair of parts, to be dispatched with parts for repair purposes.

**F.1.155 info parts to be replaced:** the specific information relating to replacement of parts.

**F.1.156 info parts to be serviced:** the specific information on the servicing of parts after disassembly of the ship/system.

**F.1.157 information sub-assemblies:** the information on steel sub-assemblies.

**F.1.158 inspection information:** the information resulting from previous inspection which may be used for maintenance and repair purposes.

**F.1.159 inspect ship/system (A42322):** the activity which leads to the inspection of a ship and its equipment.

**F.1.160 install auxiliary equipment (A3334):** the activity which leads to the installation of the auxiliary equipment.

**F.1.161 install equipment (A333):** the activity which leads to the installation of the equipment.

**F.1.162 install machinery (A3332):** the activity which leads to the installation of the machinery.

**F.1.163 install modular build units\* (A332):** the activity which leads to the installation of modular build units.

**F.1.164 install modular machinery systems\* (A334):** the activity which leads to the installation of modular machinery systems.

**F.1.165 installed equipment:** the ship equipment as-installed information.

**F.1.166 integrate changes on auxiliary equipment design (A25131):** the process of including design refinements in the auxiliary equipment design in order to generate the final design.

**F.1.167 integrate changes on deck machinery design (A25151):** the process of including design refinements in the deck machinery design in order to generate the final design.

**F.1.168 integrate changes on main engine design (A25111):** the process of including design refinements in the main engine design in order to generate the final design.

**F.1.169 knowledge and experience:** the previous experience and knowledge of companies involved throughout the ship lifecycle.

**F.1.170 laws, rules and regulations :** national laws, statutory regulations and classification society rules that are used to control the design, manufacture, operation, maintenance and scrapping of the ship.

**F.1.171 list of items to be inspected:** the list of ship items, provided by the classification society or any other authorities to the owner, which needs to be inspected.

**F.1.172 list of required certificates\*:** as a result of placing an order, this is the list supplied by the ship owner for certificate requirements.

**F.1.173 list of required personnel:** the list of technical personnel, for carrying out the specific task, including numbers, training and skill (experience) information.

**F.1.174 list of required resources:** the list of required resources including required tools, equipment, material and personnel for completion of a task.

**F.1.175 list of tools and equipment:** the list of tools and equipment needed to carry out a task.

**F.1.176 loading and stability manual\*:** the document which details loading and stability information for use by the ship operator.

**F.1.177 loading conditions\*:** standard loading conditions, defining the quantities of cargo, ballast water and consumables such as fuel oil and lubrication oil, in each space or compartment, which is used as a basis for design.

**F.1.178 logbook:** the shipboard documentation, recording the main aspects of ship and equipment's operation characteristics, events etc. The logbook is updated daily.

**F.1.179 machinery design:** the design drawings and electronic models of the ship mechanical systems. An output from the final design process.

**F.1.180 machinery systems:** an engineering system comprising of reciprocating or rotating equipment with the primary function of providing mechanical power against a load.

**F.1.181 main engine:** the information required in order to select the main engine.

**F.1.182 maintain a ship (A42):** the activity of bringing up a ship to its acceptable sailing condition, normally after a failure or a predefined period of operation.

**F.1.183 maintain at base (A422):** the execution of the maintenance task at base (port).

**F.1.184 maintain at yard (A423):** the execution of the maintenance task at shipyard.

**F.1.185 maintain on board (A421):** the execution of the maintenance task on-board ship at sea.

**F.1.186 maintenance history:** the documented history of maintenance information, normally beginning with the commissioning phase of ship lifecycle.

**F.1.187 maintenance personnel:** the personnel or crew needed to perform the maintenance activity.

**F.1.188 maintenance reports:** documents (reports) which describe all aspects of a specific completed maintenance task including procedures used, equipment or system information, actions carried out and results.

**F.1.189 make report (A421426):** the activity which leads to the preparation of the task report.

**F.1.190 make report (A423126):** the activity which leads to the preparation of the task report.

**F.1.191 manoeuvring system:** a system used to perform planned movement or change from the straight steady course and speed of a ship.

**F.1.192 manoeuvring system design:** the design specification and drawings of the ship manoeuvring system.

**F.1.193 manufacturing restrictions :** a constraint on the ship construction and design processes governed by available technology and shipyard facilities.

**F.1.194 material allocation/ordering\*:** the data describing the necessary material supply for production.

**F.1.195 material and certificates\*:** the name and specification of materials and the required quality and quantity certificates.

**F.1.196 material data\*:** the specification of material properties.

**F.1.197 material list\*:** the list of raw materials needed to manufacture the ship. A result of the final design process.

**F.1.198 measurement report:** the document (report) containing the measured values of a parameter from an instrument, related to condition (status) of systems.

**F.1.199 model basin consultants\*:** the organisations which perform model basin tests to calculate hydrodynamics and powering data.

**F.1.200 model basin theory\*:** the theory, along with empirical data, used by the model basin consultants to calculate the hydrodynamics and powering information.

**F.1.201 modifications from machinery:** modifications due to changes to machinery.

**F.1.202 modification to hull form\*:** modifications to the hull shape due to feedback from hydrodynamics and powering results and the final design process.

**F.1.203 modular build units\*:** the modular assemblies of ship steel sub-sections, normally produced in the shipyard. These are later on assembled onto the ship.

**F.1.204 modular machinery systems\*:** the modular assemblies of ship machinery systems, either assembled in or delivered to the shipyard. These are later on assembled onto the ship.

**F.1.205 monitor status (A4211):** the process of monitoring the status of equipment.

**F.1.206 noise and vibration level:** the equipment and system noise and vibration levels that influence the design of ship systems.

**F.1.207 notify owner about items due to survey (A431):** the activity by which the ship owner is informed of the items which need to be surveyed by the class society.

**F.1.208 observe signal (A42111):** the activity or process by which a specific signal or parameter is being monitored.

**F.1.209 offer\*:** the result of the preliminary design process. It will contain the shipyard's data for producing the requested ship.

**F.1.210 offer guidelines\*:** the offer guidelines include the data necessary to make an unconditional offer to the ship owner.

**F.1.211 on-board material data:** the data relating to spare parts and consumables for on-board maintenance.

**F.1.212 on-board tools and equipment:** the tools and testing equipment, on-board-ship, needed for maintenance.

**F.1.213 operate and maintain a ship (A4):** the activity that describes the running and maintenance of the ship during its service lifetime.

**F.1.214 operate a ship (A41):** the activity of keeping a ship in operation.

**F.1.215 operational history:** the operational historical data, normally recorded in the ship logbook.

**F.1.216 operational information:** accumulated information during the operation phase of the ship used for maintenance and in the final scrapping stage.

**F.1.217 operation manual:** the document (manual) describing how an equipment or system should be operated.

**F.1.218 owner :** the organisation which requests, orders and takes delivery of the ship.

**F.1.219 owner request, requirements :** the requirements document that is submitted to the shipyard by the owner upon the invitation to tender.

**F.1.220 perform design approval (A2521):** the activity which is mainly carried out by the classification society in approving the design of certain equipment and systems.

**F.1.221 perform maintenance (A4214):** the activity of carrying out a maintenance task.

**F.1.222 perform maintenance (A4231):** the activity of carrying out a maintenance task.

**F.1.223 perform ship lifecycle (A0):** all of the lifecycle activities associated with a ship.

**F.1.224 place order\* (A13):** the owner places an order for a ship from the bids that have been submitted. From this a contract is awarded.

- F.1.225 planned maintenance system:** a software system relying on the data created during the final design process and used during the operation and maintenance of the ship.
- F.1.226 power requirements for engine:** the engine power resulting from the hydrodynamics and powering calculations which is used in the selection of the main engine.
- F.1.227 pre-layout\*:** the very initial layout of the ship which is produced during the bid evaluation stage and is the basis for the preliminary design.
- F.1.228 predict brake power and service speed\* (A122314):** the activity that estimates the required propulsive power and speed in order to be able to choose the correct size of main engine and propeller.
- F.1.229 predict propeller performance (A122313):** the activity that uses propulsion data to produce an initial propeller functional design.
- F.1.230 predict propulsion data\* (A122312):** an activity that estimates propulsion data including propulsive power and other data, such as propulsive coefficient, propeller coefficient, hull efficiency, relative rotative efficiency, thrust deduction fraction and wake fraction.
- F.1.231 predict resistance\* (A122311):** the activity that predicts the ship resistance. The resistance calculation will be done using historical data related to the geometry of the ship.
- F.1.232 preliminary design :** the preliminary ship design, which is completed in the phases leading up to the submittance of the tender.
- F.1.233 preliminary hull form\*:** the definition of the hull form, as a result of the preliminary design process. Used in the offer documents and for preliminary hydrodynamics and powering calculations.
- F.1.234 preliminary machinery design:** the overall specifications of the ship mechanical systems, resulting from the preliminary design process. Used in the offer document and for preliminary compartment design, hydrodynamics and powering calculations.
- F.1.235 preparation report:** a document.
- F.1.236 prepare bid (A12):** all activities of the shipyard regarding preparation and submission of the offer to the ship owner for the ship to be built.
- F.1.237 prepare for maintenance at base/yard (A4215):** all activities relating to the preparation of the ship or its equipment/systems for a maintenance task to be carried out at the base harbour/shipyard.
- F.1.238 prepare maintenance (A42141):** all activities relating to the preparation of the ship or its equipment/systems for a maintenance task.
- F.1.239 prepare maintenance (A42311):** all activities relating to the preparation of the ship or its equipment/systems for a maintenance task.
- F.1.240 prepare ship for survey (A433):** all activities relating to the preparation of a ship or its equipment/systems for survey.
- F.1.241 present offer\* (A125):** the activity concerned with presentation of the offer to the ship owner for building a new ship.

**F.1.242 preventive maintenance procedures:** the document describing the procedures for preventive maintenance.

**F.1.243 previous design\*:** an existing ship design, that is used as the basis for a new ship design.

**F.1.244 produce and approve reference documents\* (A35):** the activity of creating the technical documentation for the ship, using production information. The output includes the loading and stability manual.

**F.1.245 produce and inspect ship (A3):** the activity that describes how the design is transformed into a real product. In the production phase the design has to prove its produceability. The production is controlled by the schedule, the approved design, the contract and any manufacturing restrictions. The result of the activity is the completed ship and technical documentation and certificates.

**F.1.246 produce modular build units\* (A32):** the activity which leads to the production of the modular units which will make up the completed ship. They are produced from the steel sub-sections and their production is controlled by the schedule, contract, the approved design, and any manufacturing restrictions. The results of the activity are the modular units which are assembled into the ship.

**F.1.247 produce steel sub-sections\* (A31):** the activity which leads to the production of the steel sub-sections which make up the structure of the completed ship. This is controlled by the schedule, contract, the approved design, and any manufacturing restrictions.

**F.1.248 product component information:** the technical data of the components that will be incorporated into the ship. These are taken into consideration when the preliminary designs are being made.

**F.1.249 production information\*:** information describing a product, e.g. dimensions, mechanical properties, workshop information.

**F.1.250 product model data:** information describing a product. In this case, all the information about the ship over its lifecycle belongs to the product model data.

**F.1.251 propeller design:** the design of the propeller or propulsor as a result of the hydrodynamics and powering calculations. The design controls some of the machinery design activity.

**F.1.252 propeller functional design:** the functional design data of the propeller.

**F.1.253 propeller theory:** the body of knowledge based on the historical experience and abstract ideas of ship propeller performance.

**F.1.254 proposed designs\*:** the output from the preliminary design stage that includes the best short list of ship designs that satisfies the proposed owner's requirements.

**F.1.255 qualification requirements:** the required qualification of the personnel to be allocated to a task

**F.1.256 quality assurance\*:** an organisation within the shipyard that has the task to audit the shipyard organisation and applied processes in a manner such that the quality of the resulting product is assured.

**F.1.257 refined design for classification:** the new design which would require the approval of the classification society.



**F.1.258 regular wave theory \***: the body of knowledge which relates the motion response of a ship in waves of constant height and period.

**F.1.259 release for operation (A4232)**: the process of releasing a ship for operation.

**F.1.260 relevant data**: the data needed for carrying out a specific task.

**F.1.261 repair information**: the information about the repair task including procedures, resource data and organisation responsible.

**F.1.262 repair parts (A421423)**: the activity which leads to the maintenance of parts.

**F.1.263 repair parts (A423123)**: the activity which leads to the maintenance of parts.

**F.1.264 request a ship\* (A11)**: the first activities of a ship owner when intending to order a ship. Having definite ideas regarding appearance and functionality of the ship, the owner expresses these ideas in an inquiry to the shipyard.

**F.1.265 request for additional data**: a request for extra information to enable the completion of a task.

**F.1.266 request for changes\***: changes that are requested to the ship design as a result of production experience or difficulties with the realisation of the ship design.

**F.1.267 request for other level maintenance**: the request for maintenance on another level as a result of a diagnosis activity.

**F.1.268 request to change corrective actions**: the request for changing the corrective actions for reasons that there are strong concerns about the feasibility of the planned actions.

**F.1.269 request to change corrective maintenance plan**: the request for changing the corrective maintenance plan for stated reasons.

**F.1.270 request to change working plan**: the request for changing the applicable working plan for reasons stated in the request.

**F.1.271 resistance and powering results**: the results for the resistance and powering of the ship determined from model tests.

**F.1.272 resistance and shaft power**: the ship resistance and required propulsive power.

**F.1.273 resistance theory\***: the theory used to predict the resistance of the hull to forward motion in the sea.

**F.1.274 resource allocation\***: the result of the capacity planning.

**F.1.275 resources**: shipyard, classification society and consultants.

**F.1.276 results of zigzag, initial turning etc.\*** : the manoeuvring test results as from model basin tests or sea trials.

**F.1.277 review maintenance report (A42321)**: the activity which analyses the maintenance report.

**F.1.278 reviewed maintenance report:** the document (maintenance report) which has undergone full review.

**F.1.279 scantling requirements for plates stiffeners and other strength elements for all the panels, surrounding this tank\*:** the dimension of stiffeners and other strength elements.

**F.1.280 schedule:** the time table for a task.

**F.1.281 schedule (A421411):** the preparation of the time table for a task.

**F.1.282 schedule (A423111):** the preparation of the time table for a task.

**F.1.283 scrap a ship:** all activities relating to the last stage of the ship's lifecycle. It consists of the decommissioning and dismantling of the ship.

**F.1.284 scrapping plan:** the document which provides the schedule and resources required to dismantle the ship.

**F.1.285 select auxiliary equipment (A12253):** the activities which lead to the selection of auxiliary equipment.

**F.1.286 select components (A122521):** the activity which leads to the selection of ship equipment.

**F.1.287 select components (A122541):** the activity which leads to the selection of ship equipment.

**F.1.288 select deck machinery (A12255):** the activity which leads to the selection of deck machinery.

**F.1.289 select main engine (A12251):** the activities which lead to the selection of the main engine by the shipyard.

**F.1.290 service information:** the information/data about the service activities.

**F.1.291 service load required draughts etc.\*:** information about the service activities of the ship.

**F.1.292 service parts (A421422):** the activity of testing, upgrading and changing parts within a survey or maintenance activity.

**F.1.293 service parts (A423122):** the activity of testing, upgrading and changing parts within a survey or maintenance activity.

**F.1.294 ship :** a large waterborne vessel whose design, manufacture and lifecycle operation is governed by the principles of naval architecture and in accordance with international and classification society regulations.

**F.1.295 ship product data:** the data describing the ship as a product.

**F.1.296 ship weight modifications\*:** modification to ship weight due to the preliminary structure design.

**F.1.297 shipyard:** an organisation that designs and builds, maintains or repairs ships.

**F.1.298 shipyard and classification society:** the shipyard and classification society organisations.

**F.1.299 shipyard and consultants:** the resources of the shipyard which builds the ship and consultants who provide assistance in design.

**F.1.300 shipyard (experts and tools):** the shipyard's experts and software tools are the means by which the ship design is carried out.

**F.1.301 short and long term responses\* :** the results of estimation of sea keeping ability that take into account both short term journeys in local seas and long term world wide journeys.

**F.1.302 signal:** any indicative thing such as measured values by meters, a visual impression etc.

**F.1.303 specify and select auxiliary equipment (A122532):** all activities associated with defining the specification of auxiliary equipment and its selection.

**F.1.304 specify and select deck machinery (A122551):** all activities associated with defining the specification of deck machinery and its selection.

**F.1.305 specify and select main engine (A122511):** all activities associated with defining the specification of the main engine and its selection.

**F.1.306 specify initial propeller characteristics (A1223131):** the activity which leads to the definition of overall propeller characteristics.

**F.1.307 specify ship (A1) :** all activities associated with the production of a detailed specification of the ship prior to a contract being placed.

**F.1.308 speed :** the design speed of the ship, as specified by the owner in the contract.

**F.1.309 status report:** a document (report) detailing the status of an equipment or system. The status report results from condition monitoring.

**F.1.310 steel sub-sections:** the sub-sections of the steel structure which are outfitted with the machinery and distribution systems before assembly.

**F.1.311 structural design\* :** the design of the hull structure including hull, bulkheads, decks and stiffeners.

**F.1.312 structure\*:** the steel structure of the ship including hull, bulkheads, decks and stiffeners.

**F.1.313 sub-sections\*:** the steel sub-sections of a ship structure.

**F.1.314 suppliers:** the organisations which supply equipment to shipyard and ship owner.

**F.1.315 support :** all the organisations and personnel who contribute to the lifecycle of the ship.

**F.1.316 survey a ship (A43):** the activity which leads to the survey of a ship or its equipment.

**F.1.317 survey a ship (A434):** the activity which leads to the survey of a ship or its equipment.

**F.1.318 survey plan:** a document outlining the details of a survey plan with information such as critical areas, corrosion, risk schema, name of components/systems to be inspected.

**F.1.319 survey planning (A432):** the activity which leads to preparation of a survey plan.

**F.1.320 survey report:** the document (report) stating the results and details of a survey activity.

**F.1.321 survey status:** the data specifying the current status of a ship with regard to survey.

**F.1.322 tank usage documentation:** a document specifying the usage of a tank.

**F.1.323 technical documentation:** the documents which provide technical description for performing preventive maintenance.

**F.1.324 technical documentation inspection report:** a document.

**F.1.325 technical requirements\* :** the detailed ship specification issued by the owner on the award of a contract to build a ship.

**F.1.326 test (A421425):** the activity of testing a part, a component, equipment or a system to its performance according to the specification.

**F.1.327 test (A423125):** the activity of testing a part, a component, equipment or a system to its performance according to the specification.

**F.1.328 test results:** the maintenance test results are the results of functional tests carried out after the execution of maintenance tasks.

**F.1.329 test ship (A34):** this activity tests the actual ship against the design, contract and rules and regulations. The structure is tested and sea trials including testing of machinery are carried out. The test results are an output from this activity.

**F.1.330 test structures\* (A341):** the steel structures are tested against rules and regulations and the design. The output is the test result documentation.

**F.1.331 test systems (A342):** the ship's systems including outfitting, machinery and mission systems are tested against rules and regulations and the design. The output is the test result documentation.

**F.1.332 time/cost criteria:** the shipyard criteria for calculating cost and time of a task (e.g. maintenance).

**F.1.333 time/cost overview:** estimated cost/time needed for carrying out a task.

**F.1.334 tools and equipment ready for use:** the details of available tools and equipment for maintenance.

**F.1.335 tools and equipment requirements:** the details of required tools and equipment for maintenance.

**F.1.336 total resistance\*:** the resistance of the hull due to motion in the water.

**F.1.337 transmission system:** a system by which motive power from a prime mover is made available at load and matched to load (e.g. shafting system connecting main engine to propeller, or shafting system connecting auxiliary engine to generator).

**F.1.338 transmission system design:** the definition of the transmission system design. Includes all the information, normally in drawing form, including those of the selected equipment.

**F.1.339 transportation needs:** a constraint which determines the specification for ship constructions.

**F.1.340 update logbook (A42324):** the activity of recording new operational data in the ship logbook.

**F.1.341 update maintenance history (A42325):** the activity of recording new maintenance data in the ship maintenance history document.

**F.1.342 updated logbook:** the logbook resulting from the inclusion of new operational data.

**F.1.343 updated maintenance history:** the maintenance history document resulting from inclusion of new maintenance data.

**F.1.344 updated survey status:** the status report resulting from inclusion of new survey data.

**F.1.345 validate initial propeller (A1223136):** the activity of validating the initial propeller design for satisfying the hydrodynamic and powering requirements of the ship.

**F.1.346 weights and compartmentation\*:** the ship arrangement and weight details.

**F.1.347 weights distribution\*:** the details of the weight distribution taking account of steel weight, machinery weights and cargo and the associated floating position of the ship.

**F.1.348 work calculation data\*:** the data such as labour rates, depreciation rates, operating costs etc. needed for calculation of financial estimates.

**F.1.349 work load\*:** the total effort required to build the chosen ship design as estimated by the shipyard and its consultants.

**F.1.350 write/select instructions (A421412):** the process of selecting the instructions needed for carrying out a task.

**F.1.351 write/select instructions (A423112):** the process of selecting the instructions needed for carrying out a task.

**F.1.352 yard:** an organisation that designs and builds, maintains or repairs ships.

**F.1.353 yard facilities:** all the equipment, tools, infrastructure, personnel etc. of a shipyard used for ship production.

**F.1.354 yard material data\*:** the data relating to available, equipment, tools, components, parts and raw material in a shipyard.

**F.1.355 yard personnel\*:** the technical personnel of a shipyard.

**F.1.356 yard staff\*:** the staff of a shipyard.

**F.1.357 yard tools and equipment\*:** the tools and equipment of a shipyard.

## **F.2 Application activity model diagrams**

The application activity diagrams are given in Figures F.1 to F.44. The graphical form of the application activity model is presented in the IDEF0 activity modelling format. Activities and data flows that are out of the scope of this part of ISO 10303 are marked with asterisks.

**Figure F.1 – Node A0: ship life cycle description**

**Figure F.2 – Node A0: perform ship life cycle**



**Figure F.3 – Node A1: specify ship**

**Figure F.4 – Node A12: prepare bid**

**Figure F.5 – Node A122: create preliminary design**

**Figure F.6 – Node A1223: estimate hydrodynamics and powering**

**Figure F.7 – Node A12231: estimate resistance and powering**

**Figure F.8 – Node A122313: predict propeller performance**

**Figure F.9 – Node A1225: create preliminary machinery design**

**Figure F.10 – Node A12251: select main engine**



**Figure F.11 – Node A12252: design transmission system**

**Figure F.12 – Node A12253: select auxiliary equipment**

**Figure F.13 – Node A12254: design manoeuvring systems**

**Figure F.14 – Node A12255: select deck machinery**

**Figure F.15 – Node A2: complete and approve ship design**

**Figure F.16 – Node A25: complete design of ship machinery**

**Figure F.17 – Node A251: finalise machinery design**

**Figure F.18 – Node A2511: finalise main engine selection**



**Figure F.19 – Node A2512: finalise transmission system design**

**Figure F.20 – Node A2513: finalise auxiliary equipment selection**

**Figure F.21 – Node A2514: finalise manoeuvring system design**

**Figure F.22 – Node A2515: finalise deck machinery design**

**Figure F.23 – Node A252: approve design of ship machinery**

**Figure F.24 – Node A2522: check design against rules and regulations**

**Figure F.25 – Node A3: produce and inspect ship**

**Figure F.26 – Node A33: assemble ship**



**Figure F.27 – Node A333: install equipment**

**Figure F.28 – Node A34: test ship**

**Figure F.29 – Node A4: operate and maintain a ship**

**Figure F.30 – Node A42: maintain a ship**

**Figure F.31 – Node A421: maintain on board**

**Figure F.32 – Node A4211: monitor status**

**Figure F.33 – Node A4212: diagnose**

**Figure F.34 – Node A4213: adjust maintenance programme**



**Figure F.35 – Node A4214: perform maintenance**

**Figure F.36 – Node A42141: prepare maintenance**

**Figure F.37 – Node A42142: execute maintenance**

**Figure F.38 – Node A423: maintain at yard**

**Figure F.39 – Node A4231: perform maintenance**

**Figure F.40 – Node A42311: prepare maintenance**

**Figure F.41 – Node A42312: execute maintenance**

**Figure F.42 – Node A4232: release for operation**



**Figure F.43 – Node A43: survey a ship**

**Figure F.44 – Node A432: survey planning**

## **Annex G**

(informative)

### **Application reference model**

This annex provides the application reference model (ARM) for this part of ISO 10303. The application reference model is a graphical representation of the structure and constraints of the application objects specified in clause 4. The application reference model is independent from any implementation method.

The graphical form of the application reference model is presented in EXPRESS-G. Figures G.1 to G.46 give the ARM for this part of ISO 10303.

**Figure G.1 - Graphical notation of the major aspects of the  
configuration\_definitions UoF schema (figure 1 of 1)**

**Figure G.2 - Graphical notation of the major aspects of the cranes UoF schema (figure 1 of 3)**

**Figure G.3 - Graphical notation of the major aspects of the cranes UoF schema (figure 2 of 3)**

**Figure G.4 - Graphical notation of the major aspects of the cranes UoF schema (figure 3 of 3)**

**Figure G.5 - Graphical notation of the major aspects of the  
diesel\_engines UoF schema (figure 1 of 2)**



**Figure G.6 - Graphical notation of the major aspects of the  
diesel\_engines UoF schema (figure 2 of 2)**

**Figure G.7 - Graphical notation of the major aspects of the  
external\_references UoF schema (figure 1 of 1)**

**Figure G.8 - Graphical notation of the major aspects of the  
gas\_material\_properties UoF schema (figure 1 of 1)**

**Figure G.9 - Graphical notation of the major aspects of the  
lifting equipments UoF schema (figure 1 of 1)**

**Figure G.10 - Graphical notation of the major aspects of the  
liquid\_material\_properties UoF schema (figure 1 of 2)**

**Figure G.11 - Graphical notation of the major aspects of the  
liquid\_material\_properties UoF schema (figure 2 of 2)**

**Figure G.12 - Graphical notation of the major aspects of the  
local\_co\_ordinate\_systems UoF schema (figure 1 of 1)**

**Figure G.13 - Graphical notation of the major aspects of the  
machineries UoF schema (figure 1 of 2)**



**Figure G.14 - Graphical notation of the major aspects of the  
machineries UoF schema (figure 2 of 2)**

**Figure G.15 - Graphical notation of the major aspects of the  
maintenance\_tasks UoF schema (figure 1 of 1)**

**Figure G.16 - Graphical notation of the major aspects of the  
measure\_with\_units UoF schema (figure 1 of 1)**

**Figure G.17 - Graphical notation of the major aspects of the  
mechanical\_machineries UoF schema (figure 1 of 1)**

**Figure G.18 - Graphical notation of the major aspects of the mechanical\_product\_anomalies UoF schema (figure 1 of 2)**

**Figure G.19 - Graphical notation of the major aspects of the mechanical\_product\_anomalies UoF schema (figure 2 of 2)**

**Figure G.20 - Graphical notation of the major aspects of the mechanical\_product\_components UoF schema (figure 1 of 1)**

**Figure G.21 - Graphical notation of the major aspects of the  
mechanical\_product\_connections UoF schema (figure 1 of 1)**



**Figure G.22 - Graphical notation of the major aspects of the mechanical\_product\_definitions UoF schema (figure 1 of 3)**

**Figure G.23 - Graphical notation of the major aspects of the mechanical\_product\_definitions UoF schema (figure 2 of 3)**

**Figure G.24 - Graphical notation of the major aspects of the mechanical\_product\_definitions UoF schema (figure 3 of 3)**

**Figure G.25 - Graphical notation of the major aspects of the  
mechanical\_product equipments UoF schema (figure 1 of 1)**

**Figure G.26 - Graphical notation of the major aspects of the  
mechanical\_product\_general\_characteristics UoF schema (figure 1 of 1)**

**Figure G.27 - Graphical notation of the major aspects of the  
mechanical\_product\_representations UoF schema (figure 1 of 1)**

**Figure G.28 - Graphical notation of the major aspects of the mechanical\_product\_structures UoF schema (figure 1 of 2)**

**Figure G.29 - Graphical notation of the major aspects of the mechanical\_product\_structures UoF schema (figure 2 of 2)**



**Figure G.30 - Graphical notation of the major aspects of the mechanical\_product\_systems UoF schema (figure 1 of 1)**

**Figure G.31 - Graphical notation of the major aspects of the  
mechanical\_products UoF schema (figure 1 of 1)**

**Figure G.32 - Graphical notation of the major aspects of the  
other equipments UoF schema (figure 1 of 1)**

**Figure G.33 - Graphical notation of the major aspects of the  
other\_tasks UoF schema (figure 1 of 1)**

**Figure G.34 - Graphical notation of the major aspects of the  
part41\_resources UoF schema (figure 1 of 1)**

**Figure G.35 - Graphical notation of the major aspects of the  
part42\_resources UoF schema (figure 1 of 1)**

**Figure G.36 - Graphical notation of the major aspects of the  
RAM\_characteristics UoF schema (figure 1 of 1)**

**Figure G.37 - Graphical notation of the major aspects of the  
reciprocating\_machineries UoF schema (figure 1 of 1)**



**Figure G.38 - Graphical notation of the major aspects of the screw\_propellers UoF schema (figure 1 of 3)**

**Figure G.39 - Graphical notation of the major aspects of the  
screw\_propellers UoF schema (figure 2 of 3)**

**Figure G.40 - Graphical notation of the major aspects of the screw\_propellers UoF schema (figure 3 of 3)**

**Figure G.41 - Graphical notation of the major aspects of the ships UoF schema (figure 1 of 1)**

**Figure G.42 - Graphical notation of the major aspects of the  
solid\_material\_properties UoF schema (figure 1 of 1)**

**Figure G.43 - Graphical notation of the major aspects of the  
task\_definitions UoF schema (figure 1 of 2)**

**Figure G.44 - Graphical notation of the major aspects of the task\_definitions UoF schema (figure 2 of 2)**

**Figure G.45 - Graphical notation of the major aspects of the  
tasks UoF schema (figure 1 of 1)**



**Figure G.46 - Graphical notation of the major aspects of the  
time\_and\_events UoF schema (figure 1 of 1)**

**Annex H**  
(informative)

AIM EXPRESS-G

*To be completed at a later date.*

**Annex J**  
(informative)

**AIM EXPRESS listing**

*To be completed at a later date.*

**Annex K**  
(informative)

**Bibliography**

1. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY; *Integration Definition for Functional Modelling (IDEFO)* 21st December 1993, National Institute of Standards and Technology Draft Federal Processing Standards Publication 183.

## Annex L (informative)

### Technical discussion

## L.1 Introduction

This annex has been prepared in order to provide the general and introductory information on technical methodology adopted within this part of ISO 10303. This annex describes the following:

1. An introduction to STEP and ship product related Application Protocols with special reference to Part 226 on Ship Mechanical Systems.
2. Concepts common to all ship product Application Protocols, including type hierarchies related to concept of item, definitions and association of definitions to item.
3. Architecture of AP226 data model including the AP226 data planning model and description of how the full scope of AP226 is embodied in the data model.

The expected audience of this annex are those who intend to either review this part of ISO 10303 or subsequently use and implement this standard.

## L.2 STEP and Ship Application Protocols

### L.2.1 What is Step?

The STEP initiative was officially begun in 1984 as a means of facilitating concurrent engineering within the manufacturing industry. STEP is the widely used name for **ISO 10303 - Product Data Representation and Exchange** and is being developed under the guidance of the ISO Technical Sub-Committee **TC184/SC4**.

The aim of STEP, the STandard for the Exchange of Product model data, is the complete and unambiguous representation of a product such as a ship, a car, or an airplane, throughout its lifetime, in a computer interpretable neutral format. As such, the STEP initiative is directed towards enabling a product to be consistently represented from the requirement definition stage of its life, through the conceptual design, production and through-life operation and maintenance stages and then finally into the decommissioning phases. The ability to define data will enable organizations to reuse, exchange and share data to mutual advantage. With so much variety, it would be easy for STEP to be too complex to be useful. To avoid this, the STEP standard has user specific parts, each of which describes:

- The standard data definitions for that particular application area.
- How that data will be exchanged or shared

These parts are known as **Application Protocols (AP)**.

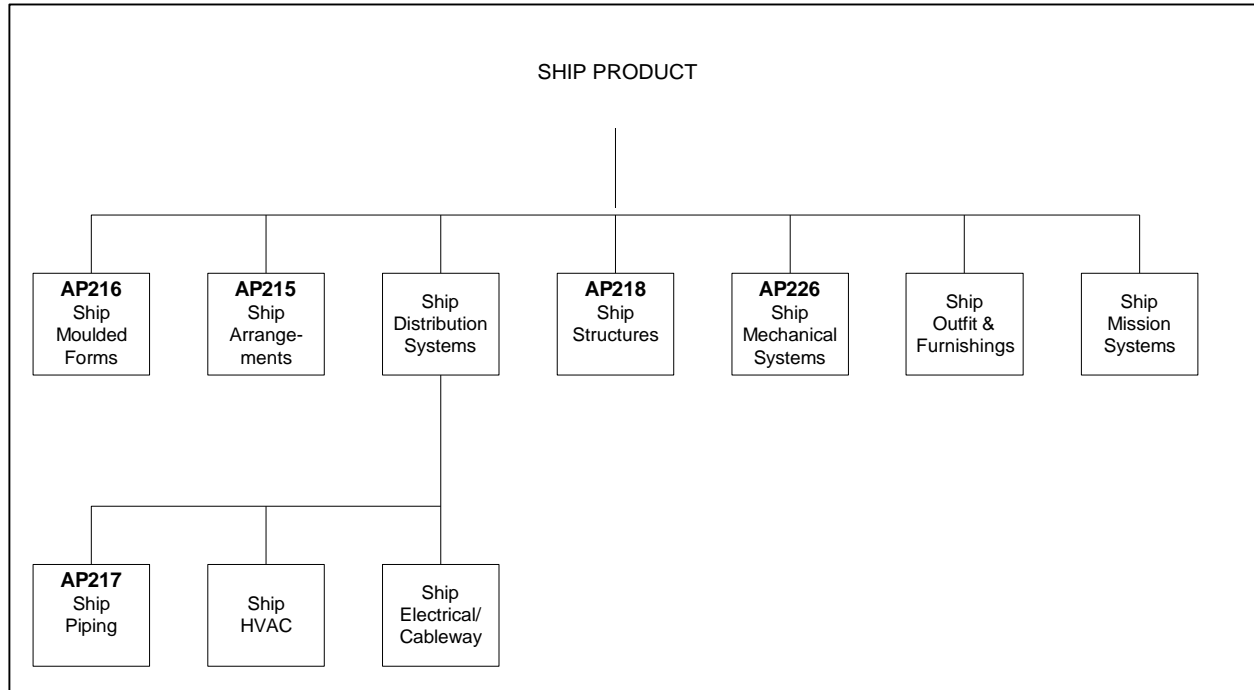
### L.2.2 The STEP Ship Model

The STEP ship model is a subset of the wider ISO STEP initiative. It currently comprises five application protocols which are under development. These are:

AP215 Ship Arrangements  
 AP216 Ship Moulded Forms  
 AP217 Ship Piping Systems

AP218 Ship Structures  
 AP226 Ship Mechanical Systems

The above series of ship product application protocols assumes that the ship as a product can be divided into separate ship systems such that each covers a key element of the ship for its entire life cycle. These key systems are: ship moulded forms, ship arrangements, ship distribution systems (piping, heating, ventilation and air conditioning, and electrical/cableway), ship structure, ship mechanical systems, ship outfit and furnishing, and ship mission systems (see Figure L.1).

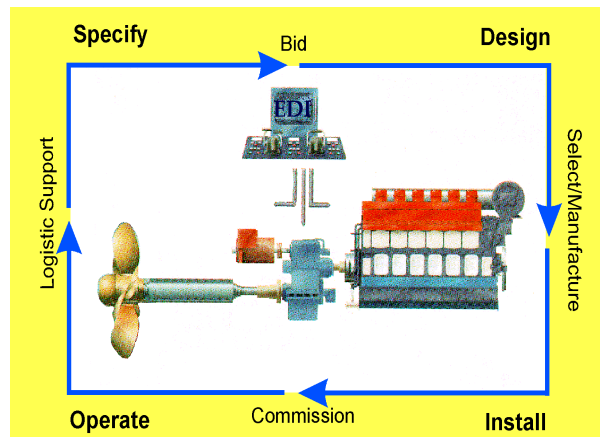


**Figure L.1 - Ship product application protocols**

Each separate system is described by one or more different application protocols. The development of these application protocols involves input from organisations from all aspects of the shipping community world-wide: shipbuilders, marine engineering component suppliers, shipowners, classification societies and so on.

### L.2.3 AP226: Ship Mechanical Systems

The scope of the AP226 encompasses the following physical systems: propulsion systems, auxiliary systems and deck machinery including all of their major equipment. Each of these systems are currently broken down into sub-groupings in order to facilitate information capture for various components within the decomposition hierarchical structure. These are documented in Annex M of this Part of ISO 10303. AP226 will provide a life cycle view of the above systems covering information requirement from concept through design/selection, operation, monitoring, inspection to decommissioning (see Figure L.2). This life cycle view will provide a powerful infrastructure for developing data storage, data handling and application modules for concurrent engineering in shipbuilding and for ship-board systems and ship to shore data communication in shipping.



**Figure L.2 - Schematic representation of ship mechanical system's life cycle concept**

### L.3 Concepts Common to Ship Application Protocols

ISO 10303-226 is being developed to support the exchange and sharing of Ship Mechanical Systems data. ISO 10303-226 has been developed in conjunction with other ship product application protocols so that important shipbuilding concepts are common and inter-operable within the STEP standard.

#### L.3.1 Mechanical Product Type Hierarchy

The method by which this part of ISO 10303 generalises and integrates the information spanning the domain of a large number of mechanical products (see 3.8.103) is via a hierarchical partitioning commonly known as a type hierarchy. The nature of such a hierarchy is that those objects close to the root of the hierarchy represent the more general objects, while those at the leaves represent the most specialised.

The main components of the type hierarchy employed in this part of ISO 10303 are shown in Figure L.3. Fundamental to the organisation of the information is the concept of the item (see 3.8.82) within the wider ship APs and the mechanical product within this part of ISO 10303. The mechanical product is a discrete identifiable thing with which definitions (see 3.8.43) and activities (see 3.8.2) are associated. It serves as the most general object from which more specialised objects are derived.

#### L.3.2 Definitions Type Hierarchy

Definitions describe mechanical products and are, as a result, the descriptive information-bearing entities of the model. A definition may be further classified as a physical, functional and so on definition. A mechanical product may have many different versions of definitions. The main components of the definitions type hierarchy employed in this part of ISO 10303 are shown in Figure L.4.

### L.4 Architecture of the data model

The main structure of the data model embodied in the ARM of AP226 is characterised as the type hierarchies shown in Figures L.3 and L.4 in which general constructs (e.g. Mechanical Product, Definition) are successfully specialised in each lower level of the hierarchy. This characteristic provides both flexibility and a mechanism by which very specialised constructs (e.g. "diesel\_engines", "RAM\_data" and so on) can be described.

In addition to flexibility and the ability to selectively specialise concepts of interest, this structure provides the following advantages;

- The top levels of the hierarchy can be effectively integrated and aligned with the core concepts and facilities common to the entire set of ship-related application protocols, thus providing for the possibility of inter-AP integration.
- The mid-levels of the hierarchy can be specialised into constructs describing the major types of shipboard systems and equipment.
- The lowest levels of the hierarchy can be fully specialised into constructs to describe specific items of mechanical products (e.g. diesel engine,.....).

In dealing with ship mechanical systems, which are effectively a composition of hundreds and thousands of various mechanical products, the approach taken seems to provide a solid basis for capturing all the industrial requirements.

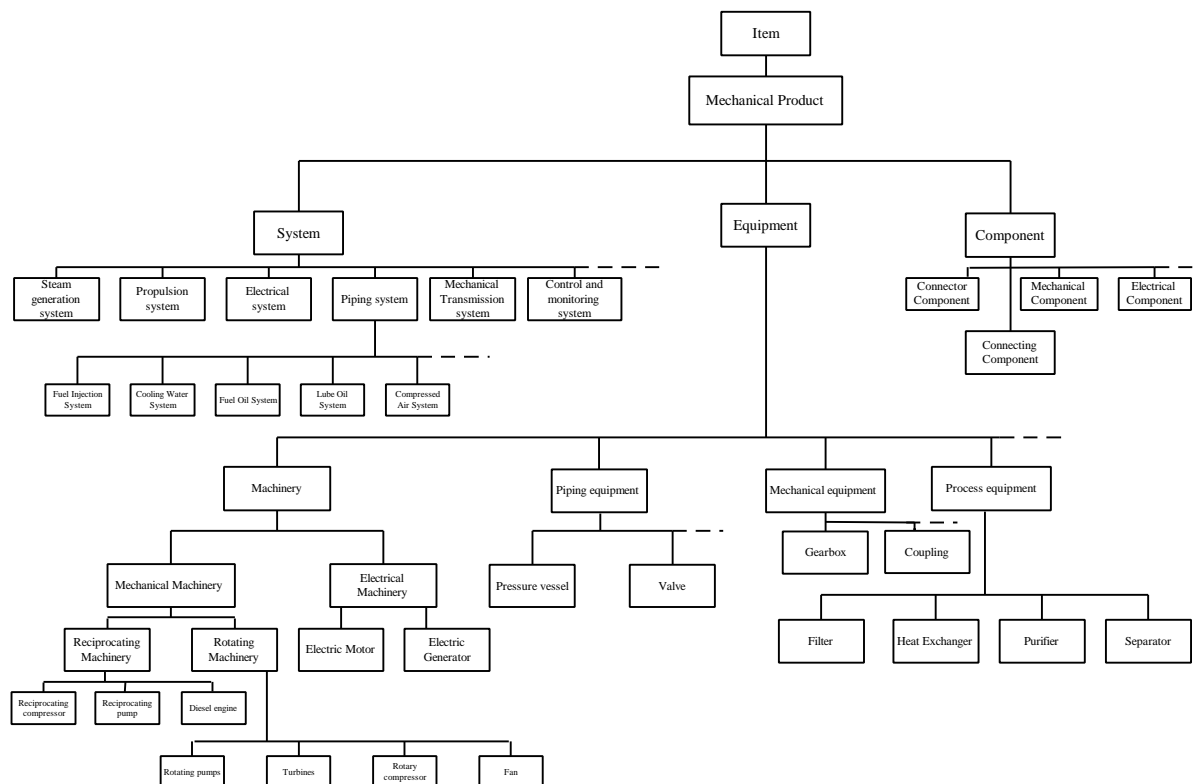


Figure L3 - Mechanical product type hierarchy



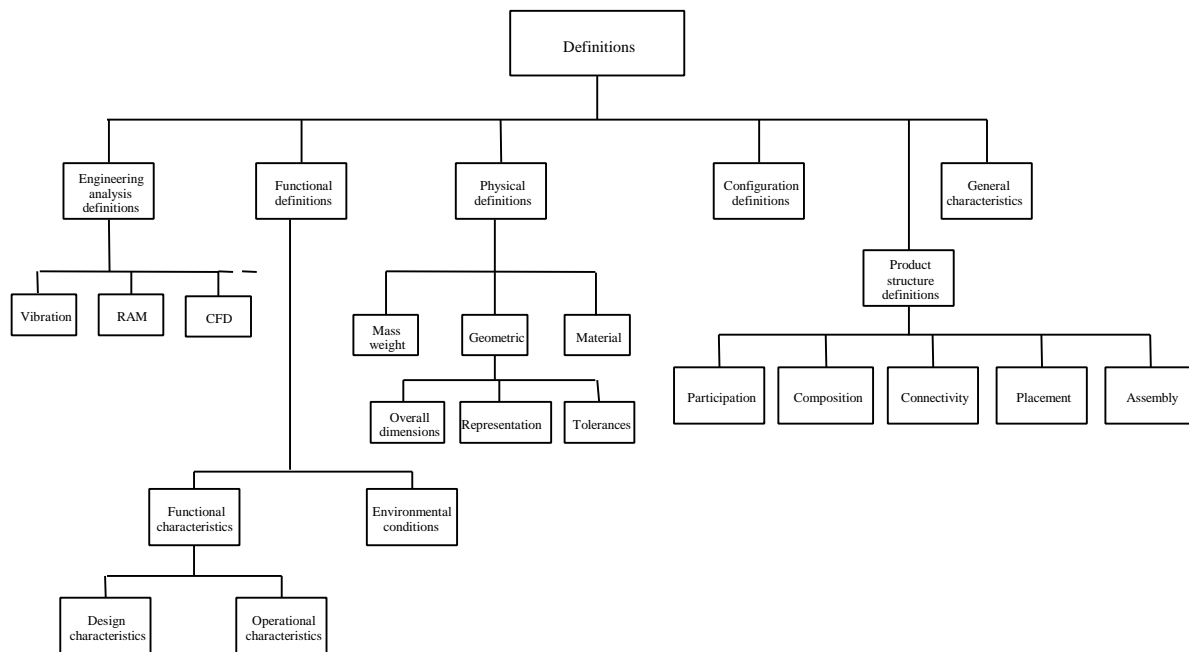


Figure L.4 - AP226 product definition type hierarchy

## L.5 AP226 Data Planning Model

### L.5.1 - What is a data planning model

A data planning model presents all the units of functionality (UoF) together with their major relationships (see Figure L.5). As such, it provides an overview of the Application Reference Model (ARM) without too much detail. It can be used to check whether the different components of the model fit properly together. It is generally agreed that such a data planning model is useful when dealing with complex product models such as those developed within STEP. The data models developed within STEP are documented in EXPRESS and EXPRESS-G and as such are not fully comprehensible to application experts. A data planning model can to some extent overcome this shortcoming.

This section presents the data planning model for AP226. The main audience of this section is assumed to be the application experts.

### L.5.2 Data planning model

Figure L.5 shows the data planning model, representing all the AP226 UoFs. A brief description of the role of each UoF follows:

**configuration\_definitions:** The configuration\_definitions UoF specifies the concepts for keeping high level records and information relating to product identification and its usage context. Concepts such as associating the product to contracts/projects and assigning the ownership of product are supported. The configuration\_definitions UoF also supports the life cycle identification of a mechanical product and whether a mechanical product represents a conceptual, designed, planned or a real thing.

**cranes:** The cranes UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a crane.

**diesel\_engines:** The diesel\_engines UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a diesel engine.

**external\_references:** The external\_references UoF specifies an external reference mechanism to assign additional documentation in electronic or non-electronic form to the product, task/activity or definitions. The external\_references UoF also facilitates access to information, standard or non-standard, on ship mechanical systems that are outside the scope of this part of ISO 10303.

**gas\_material\_properties:** The gas\_material\_properties UoF specifies the framework for grouping of the gas properties into physical, chemical and other types of properties and their association with a gaseous material.

**lifting equipments:** The lifting equipments UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a lifting equipment.

**liquid\_material\_properties:** The liquid\_material\_properties UoF specifies the framework for grouping of the liquid properties into physical, chemical and other types of properties and their association with a liquid material.

**local\_co\_ordinate\_systems:** The local\_co\_ordinate\_systems UoF specifies location of a mechanical product within the coordinate system.

**machineries:** The machineries UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a machinery (see 3.8.88).

**maintenance\_tasks:** The maintenance\_tasks UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a maintenance task.

**measure\_with\_units:** The measure\_with\_units UoF specifies the concept for representing measures for physical quantities together with their units.

**mechanical\_machineries:** The mechanical\_machineries UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a mechanical machinery (see 3.8.101).

**mechanical\_product\_anomalies:** The mechanical\_product\_anomalies UoF specifies the concept and framework for type hierarchy and grouping of different types of engineering information relating to product anomaly (see 3.8.6).

**mechanical\_product\_components:** The mechanical\_product\_components UoF specifies the concept for defining the type hierarchy and classification of the mechanical components not defined in other UoFs

**mechanical\_product\_connections:** The mechanical\_product\_connections UoF specifies the concept for defining the physical connections between mechanical products.

**mechanical\_product\_definitions:** The mechanical\_product\_definitions UoF specifies the high level concept and framework for type hierarchy and grouping of all the engineering information (descriptions and properties) which are attributable to mechanical products.

**mechanical\_product equipments:** The mechanical\_product equipments specifies the high-level concept for representing the generic class of equipment (see 3.8.58) and association of all the relevant definitions (see 3.8.43) to this class.

**mechanical\_product\_general\_characteristics:** The `mechanical_product_general_characteristics` UoF specifies the concept for collecting all the information which is attributable to general characteristics (see 3.8.77) of a mechanical product.

**mechanical\_product\_representations:** The `mechanical_product_representations` UoF specifies the concept for the representation of a mechanical product's detailed geometric definitions in the form of shape representation (solid model) and drawing. The `mechanical_product_representations` UoF also facilitates the exchange of identification information on drawings, in addition to the exchange of drawing themselves.

**mechanical\_product\_structures:** The `mechanical_product_structures` UoF defines the internal composition (see 3.8.26), external participation (being part of something else), connectivity, position and orientation of mechanical products. The `mechanical_product_structures` UoF provides the ability to exchange description of the position of a mechanical product and its arrangement.

**mechanical\_product\_systems:** The `mechanical_product_systems` UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a mechanical system (see 3.8.104).

**mechanical\_products:** The `mechanical_products` UoF specifies the high level concept for defining the type hierarchy and classification of mechanical products (see 3.8.103) in a compatible way to other ship APs.

**other equipments:** The `other equipments` UoF specifies the concept for defining the type hierarchy and classification of those equipments (see 3.8.58) which have not been defined in other UoFs.

**other\_tasks:** The `other_tasks` UoF specifies the concept for defining the high-level information relating to tasks (see 3.8.155) which have not been defined in other UoFs.

**part41\_resources:** The `part41_resources` UoF specifies all the application objects which are in ISO10303-41 and are used by this part of ISO 10303.

**part42\_resources:** The `part42_resources` UoF specifies all the application objects which are in ISO10303-42 and are used by this part of ISO 10303.

**RAM\_characteristics:** The `RAM_characteristics` UoF specifies the concept for collecting the data and information relating to a mechanical product's RAM characteristics (see 3.8.132).

**reciprocating\_machineries:** The `reciprocating_machineries` UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a reciprocating machinery (see 3.8.133).

**screw\_propellers:** The `screw_propellers` UoF specifies the concept for associating all the relevant definitions (see 3.8.43) to a screw propellers (see 3.8.136).

**ships:** The `ships` UoF specifies the information required to describe the ship. All ship product data are defined independent of the ship and have a reference to it. The `ships` UoF describes the essential information to permit that reference. This UoF is common to ship related application protocols.

**solid\_material\_properties:** The `solid_material_properties` UoF specifies the material properties and their association with a solid material.

**task\_definitions:** The task\_definitions UoF specifies the high level concept and framework for type hierarchy and grouping of all the data and information which are attributable to tasks (see 3.8.155).

**tasks:** The tasks UoF specifies the concept for defining the high-level information relating to tasks (see 3.8.155). Concepts for relating tasks to each other and identification of major aspects of relationship are also supported by the tasks UoF.

**time\_and\_events:** The time\_and\_events UoF specifies the concept for describing the events and their authorisation and approval. All the events which take place during the various stages of the ship life cycle are in the scope of the time\_and\_events UoF

**Figure L.5** - AP226 Data Planning Model

## **Annex M** (informative)

### **Mechanical System Breakdown Hierarchy**

#### **M.1 Introduction**

The AP226 scope covers the ship's mechanical systems which include the propulsion system, auxiliary systems and deck machinery. The schematic representation of the scope of AP226 is shown in Figures M.1 and M.2 (not shown).

In order to make sure that the full scope of AP226 is covered, physical and life-cycle decomposition techniques were adopted. This annex provides details of the breakdown structure for selected mechanical products.

#### **M.2 System Breakdown**

The aim of the system breakdown (decomposition) is to identify all the physical sub-systems and components of a main mechanical product. In effect, it is a hierarchical decomposition which is carried out in a top-down fashion. The decomposition is carried out to the lowest component level for which information is needed to be exchanged. This lowest level is normally defined by exchange scenarios.

The breakdown is normally illustrated either by a block diagram or by an indented table, in which each component has been assigned a level to illustrate its position within the hierarchy as well as its parent-child relationship. The breakdown structure for selected mechanical products (diesel engine, propulsor, mechanical transmission systems and manoeuvring system) has been completed and is provided in the following sections:

#### **M.3 Breakdown Structure for Diesel Engine**

This has been documented in report TID\_PE5220\_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

#### **M.4 Breakdown Structure for Propulsor**

This has been documented in report TID\_PE5220\_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

#### **M.5 Breakdown Structure for Mechanical Transmission System**

This has been documented in report TID\_PE5220\_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

#### **M.6 Breakdown Structure for Manoeuvring System**

This has been documented in report TID\_PE5220\_DD\_addendum dated 20 February 1997. *This report will be added here at a later stage.*

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